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The new MYE TECHNICAL MANUAL has received a hearty welcome from radio servicemen, amateurs, engineers, experimenters... and in training centers of the Army, Navy and Marine Corps.

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6. How to make tests which isolate the defective stage and parts.
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8. Short cuts in servicing midget universal receivers.
9. Learning how Radio circuits work through home demonstrations.
10. How to obtain additional basic Radio training for military, naval and war industry Radio jobs.
11. How accurately timed pulses are produced and used.
12. How the cathode ray tube works and is used.
13. How to adjust a Radio transmitter for best operation.
14. How to service without specialized servicing equipment.
15. How transmitters are modulated and keyed.
16. How Radio-electronic devices are used commercially as controls.
17. How Radio meters and testers work and how to use them.
18. How Radio waves are beamed and intercepted.
19. How Radio equipment is automatically and remotely controlled.
20. How a frequency modulated system works.
21. How timed circuits effect Radio circuit operation.
22. How the superheterodyne receiver works.

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Get my Sample Lesson, "How Radio Programs are Sent from the Studio to Your Home." It traces a Radio program from the studio microphone to your loudspeaker. 32 diagrams, pictures and photographs explain every step clearly. You learn the use of common Radio parts, learn to read simple diagrams, become acquainted with coils, condensers, resistors, power supplies, sound, modulation, R. F. and A. P. circuits. See for yourself how complete, how practical my Lesson Texts are. Mail the Coupon Now.



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RADIO NEWS

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VOL. 28 NO. 4

FOR THE
Record
BY THE EDITOR

U. S. Army Signal Corps Issue

AS mentioned last month, we have been hard at work preparing what we truly believe to be the most outstanding issue of RADIO NEWS ever presented in its long history. Through the cooperation of the Public Relations Staff and top ranking officers in our Signal Corps, it has been possible to prepare an authentic presentation of this—our communications branch of the service.

While we have published many outstanding articles covering various phases of activities in the Signal Corps, to the best of our knowledge no complete presentation has ever been made which reveals the tremendous scope of this organization. In order to present completely the background and functions of the Signal Corps, it becomes necessary to devote many thousands of words of explanation.

The reorganization brought about by our entry into the war and the rapid pace which has been set in the design of new equipment and techniques has brought about the necessity for a presentation of all branches and subjects, dating back to the original Signal Corps unit.

This outstanding issue is being written exclusively by Signal Corps officers featuring articles by Maj. General Dawson Olmstead, Brig. General J. A. Code Jr., Brig. General George L. Van Deusen, Col. David Sarnoff, and Lt. Col. C. J. McIntyre, to mention only a few. Profusely illustrated with color and an extensive Salon Section plus a comprehensive presentation of the official Signal Corps radio course make this issue most complete. Many other surprises await the reader, and we feel sure that the November Issue will be enthusiastically received not only by military personnel and our regular readers but by the thousands upon thousands of civilians seeking a complete story on the U. S. Army Signal Corps.

Remember too that this issue will be almost four times the size of the one you are now reading. Don't miss it!

(Continued on page 44)

★ LEADING THE INDUSTRY SINCE 1919

The Technical Magazine devoted to Radio in War, including articles for the Serviceman, Dealer, Recordist, Experimenter and Amateur

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"F. S. Bailey, Chief Engineer, Radio Operators School, Brownsville, Tex., writes: "We have found your book the best of 20 or more we have tried, both for beginners and for those who know something about radio. Student praise of it is the highest!"

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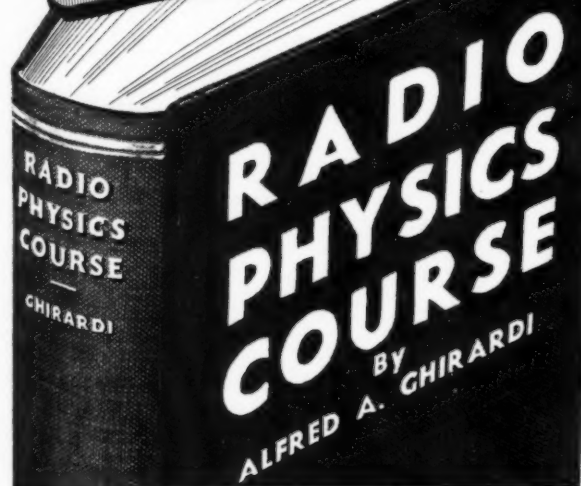
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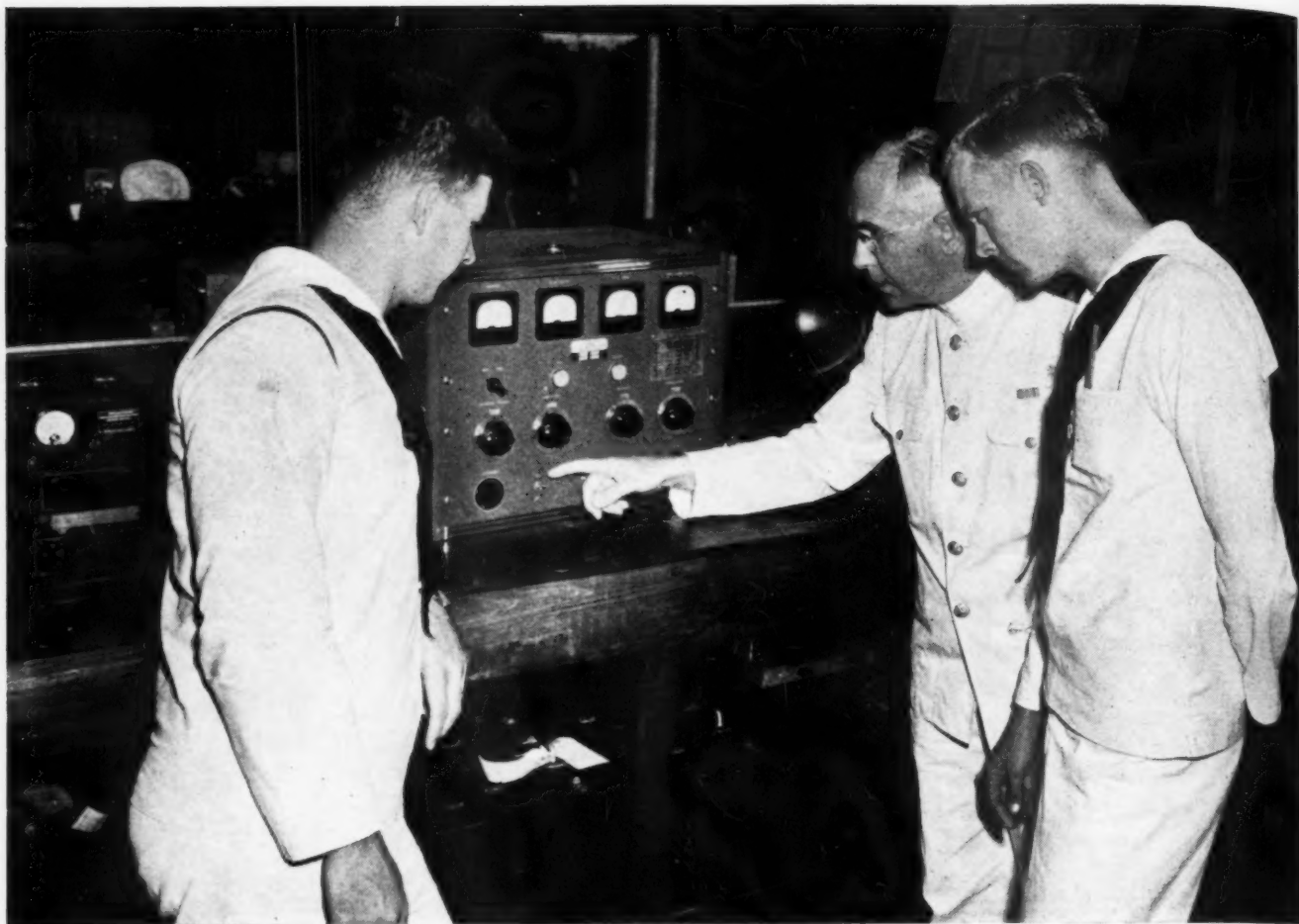
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Lieut. Collison explaining the operation of a regulation transmitter to students.

★ NAVY RADIO OPS IN THE MAKING ★

by LEWIS WINNER

The eyes and ears of our battle fleet are responsible for new techniques. Here's where radio ops are trained.

WHEN freight handlers, glass-blowers, soda dispensers, paper samplers, bartenders, hotel bell captains, and laborers, with absolutely no knowledge of radio, can within a period of sixteen weeks, be converted into expert radiomen, ready for active wartime duty, that's something to talk about. And that is exactly what is being done at the U. S. Naval Training School, Noroton Heights, Connecticut. Men from all walks of life, many of whom had not received too advanced an education,

are brought to Noroton, after they have enlisted and passed an aptitude test and put through a stiff four-month course in code, touch typing, navy procedure, and radio practice and theory. All do not pass the course, it is true, but the vast majority do and with flying colors.

The school was commissioned on October 28, 1941 and is under the command of Captain William Baggaley, a regular United States naval officer who within one month after he had received instructions to establish the

training center, did so and with 500 students as enrollees. It was quite a job, getting the material together, rearranging the offices in the building, which had been an Old Soldiers' Home and vacant for a spell. But all was in order on the day assigned for the opening and expert radiomen were soon graduating in the prescribed time. Many of those in the first class were amateurs, a fact that did ease the pressure of instruction, but the supply of amateurs did not last long, and today, ham enrollees are a rarity.

There are three types of radio classes at Noroton. One is the communications school for enlisted men, which is the major class, as far as size and time for instruction are involved. The others are the officers' training school and the naval communications pool, more familiarly known as the compool. Incidentally, there is another class at Noroton . . . a class devoted to cooking . . . an unusual project, although it has nothing to do with communications.

In the enlisted men's course, our friend "code," receives quite a featured position, for the ability to receive and transmit dots and dashes is certainly a vital requirement on land and sea. There are quite a few code and typing rooms, each devoted to a specific type of instruction, not only for speeds, but for styles of messages, and classifications of coded phrases as well as methods of interpretations.

The method of instruction is based on years of training for speed copying and transmission and as such is unusually effective. To testify to this, we were shown the records of students . . . students who had never touched a key or for that matter a typewriter either, and in copying, the ability to use a typewriter is as important as coping with the messages. In most instances, the students were able to copy at a rate of about four to eight words at the end of the fourth week. But at the end of the eighth week, the speeds jumped up to seventeen in 90% of the cases and at the end of the twelfth week, the speeds were up to twenty-nine and thirty words.

The phonetic method of instruction (entirely by sound) is used at Noroton. This speeds up the mental processes of learning and facilitates recognition of characters. If the sound system is not used, say the Noroton experts, students go through the double deciphering process, first to hear the signal and then to determine its "dot-dash" make-up. Learning by sound eliminates the second step, for the student can recognize the signal instantly as the character it represents. The real ability to copy code at high speeds, say the CRM instructors at Noroton, is the development of the knack of copying behind. This is in contrast with copying ahead, where you anticipate what is coming, a practice that is considered faulty and dangerous.

At least two characters should be carried mentally, before the characters are placed on paper. Points of instruction on this phase, simple as it may seem, are responsible for speed agility, in addition to the four basics . . . concentration, practice, confidence and patience . . . basics without which no method of instruction can be complete.

Every student is given a booklet with the foregoing information, in addition to pages of lessons, prepared in a simple yet instructive manner by Louis F. St. Amand, CRM USN (Ret.), who is an instructor at the school.

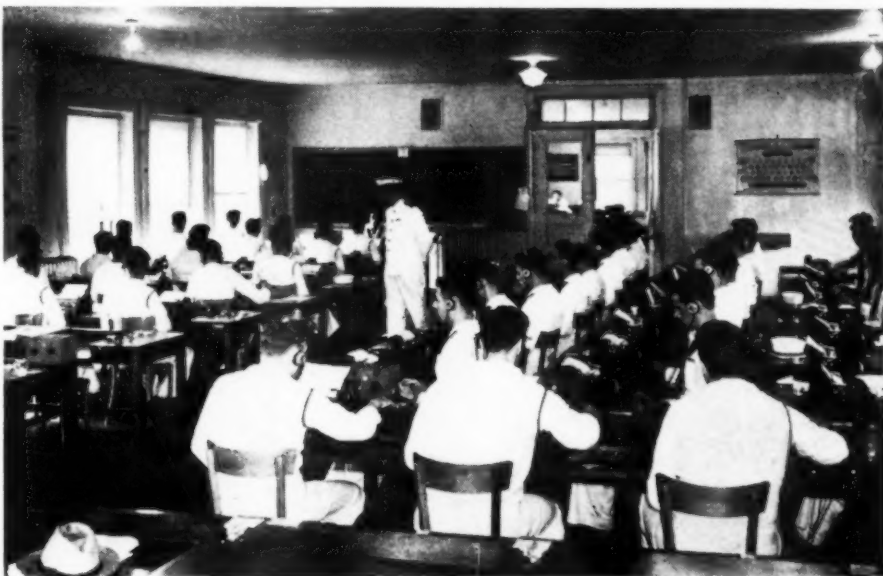


Part of the "business end" of the code source. Note the various receivers.



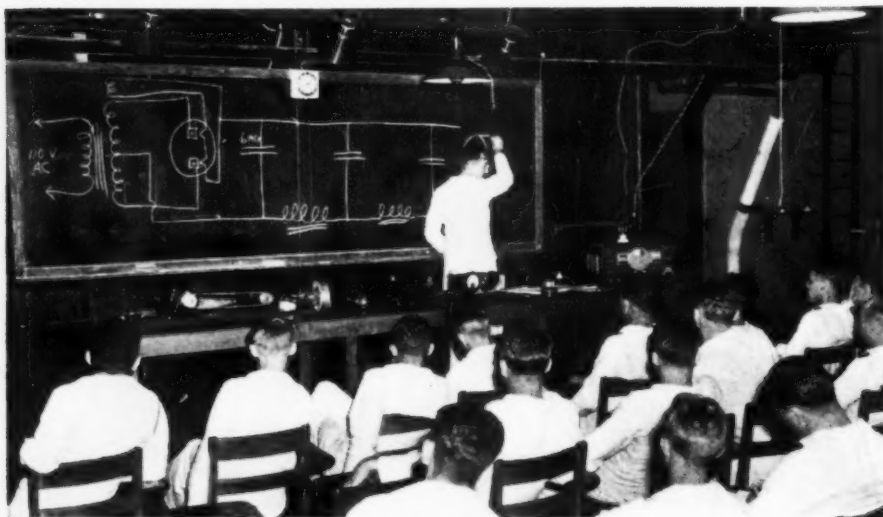
Here is where code tapes are punched. Tapes on wall are used in weekly sequence.

Instructing students in tactical procedure. Atmosphere is like the "real thing."



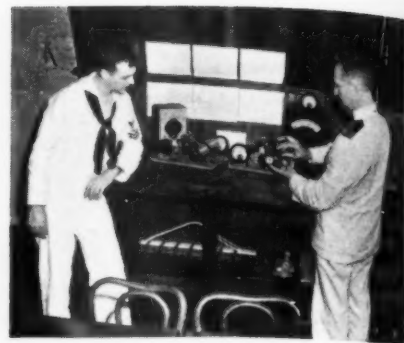
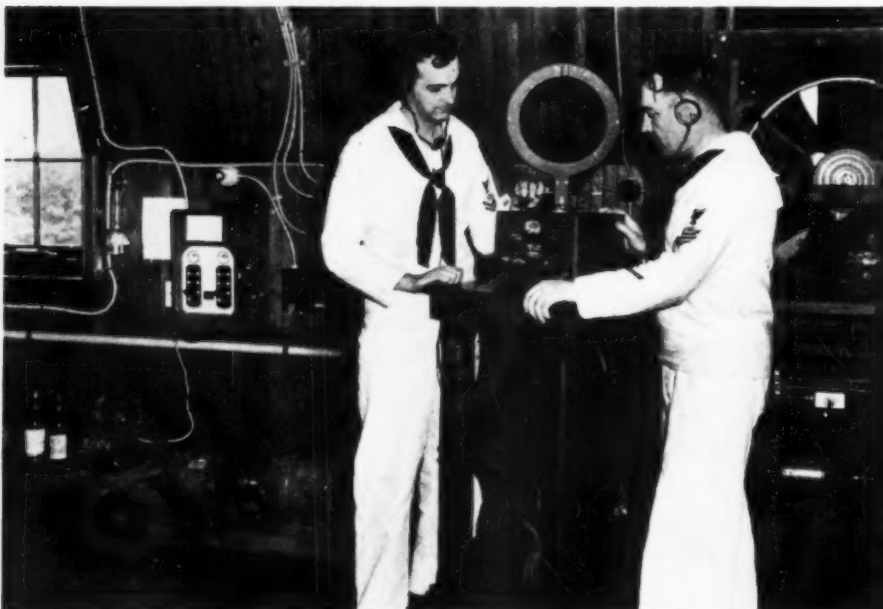


Students becoming familiar with operation of transmitters and receivers.



A class in theory is engaged in the study of conventional power supplies.

At the controls of a loop receiver in the material room at the navy school.



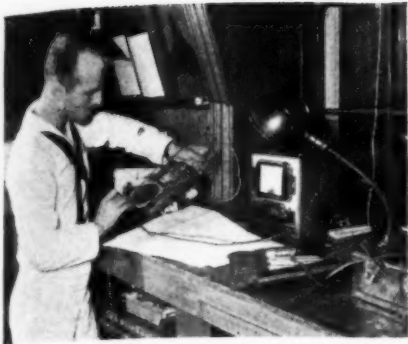
Sectional functions of part of a transmitter are being analyzed.

One of the most interesting guides to code success that the students at Noroton are given, is in the form of a graph . . . a graph that illustrates what final speed of code will be achieved by anyone, as predicated on the speeds attained during any week. For instance, if at the end of the eleventh week, the speed of a student is nineteen words, then at the end of the sixteenth week, it should be twenty-eight. While this guide is not indicated as being infallible, it serves as an effective chart, and particularly as an effective stimulant for progress. It is also an example of the pains and care to which the instruction personnel contribute to produce the expert code men, for which Noroton is so famous.

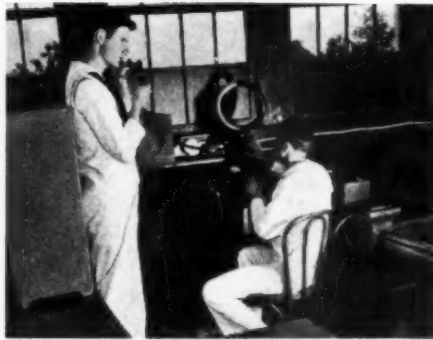
The radio materiel course constitutes another important phase of radio training at Noroton. This course is intended to develop "Radiomen Third Class Strikers," in, of course, conjunction with the code and other affiliated courses. The courses are divided into sixteen weeks, and cover nature of electricity (first week); ohm's law (second week); electric batteries and cells (third week); magnetism (fourth week); electromagnetism (fifth week); electrical generators (sixth week); motors (seventh week); electrical measuring equipment (eighth week); transformers and condensers (ninth week); vacuum tubes (tenth week); radio receivers (eleventh week); radio direction finders (twelfth week); transmitters (thirteenth week), and laboratory practice (fourteenth week). Two weeks are allowed for late starting groups, and duties which may keep the students from class. Thus, actually, the course covers a concentrated period of fourteen weeks.

During this period, blackboard instruction, book instruction and actual materiel applications are provided. The materiel being in the same room as the blackboard instruction is given, it is a simple matter to intersperse discussion with actual materiel applications and illustrations. Thus students become completely familiar with the various projects in their course of study in a practical as well as theoretical way.

Books recommended are those found to offer the greatest practical and



Continuity-testing of radio equipment is an important part of the training.



Using a direction finder in the airplane detection station at Noroton.



Student officers examine a blinker tube. It sends Morse by flashing light.

theoretical value. Among those suggested to the students are Practical Electricity by Terrel Croft; Industrial Electricity by Dawes; Practical Radio Communication by Nilson and Hornurg; Understanding Radio by Watson, Welch and Eby; Fundamentals of Radio by Everitt, Jordan, Nelson, Osterbrook, Pumphrey and Smeby; Elementary Physics by Milliken, Gole and Coyle.

The materiel used is of the latest design, from the smallest object to the largest. Students are not only given an opportunity to operate the various apparatus, but build them, too, for receiving and transmitting. Many of the units in the materiel room, used as

instruction, where students are given actual instances of application, just as if they were afloat. For instance, they receive radio watchstanding practice, and instruction in direction finding. They are taught how to repair equipment rapidly under emergency conditions.

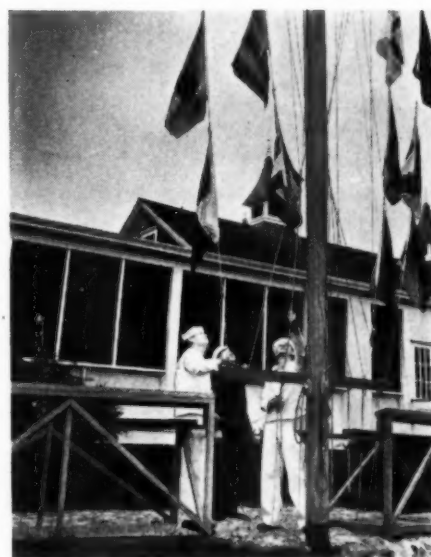
In the code rooms, actual tactical procedure is set up, with transmitting and receiving posts arranged in fashion identical to positions at sea. Thus the prospective operators become fully acclimated to actual on-the-scene conditions. About the only thing missing from these demonstrations, is the boat itself. The messages fed to the various desks, or posts, are actual navy messages and in many instances, picked up from Navy transmitters. And all the peculiar forms of background noise that may accompany such signals are fed right along with them. Hours of copying and transmitting accurately under these adverse conditions further serve to increase the alertness and proficiency of operators that come from Noroton.

Students at Noroton receive pay in accordance with their rating, while in training. In addition, the Navy pays all traveling expenses, and provides board and lodging, and the initial outfit of uniforms and equipment.

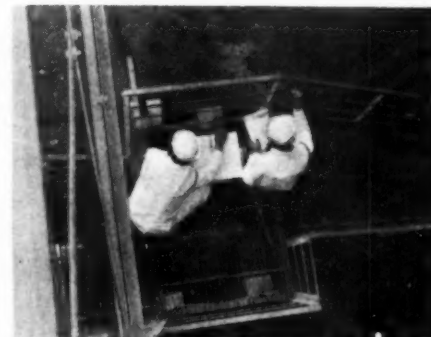
The school day is from 8 A.M. to 4 P.M., with time out for dinner and recreation. Voluntary study periods and evening classes are available for those who require additional instruction, or who wish to improve their status.

In addition to receiving instruction in radio, students are also taught seamanship, Navy regulations, first aid, and other general Naval subjects. Thus the education at Noroton is complete in every respect . . . so complete and thorough, that other Naval communications schools now being organized are adopting the entire curriculum of Noroton. And these schools include the commercial as well as universities, now training radiomen. Among these schools are Harvard (with about 1000 students), Cornell (with around 1000 students), RCA Institutes (with over 800) and the women's college at Smith, which will soon start training women for communications work.

(Continued on page 42)



Students raising signal flags on the "Flag hoist" at the Navy school.



Students sending a message by blinker to other students is part of training.

Marching from the code classrooms after strenuous session.



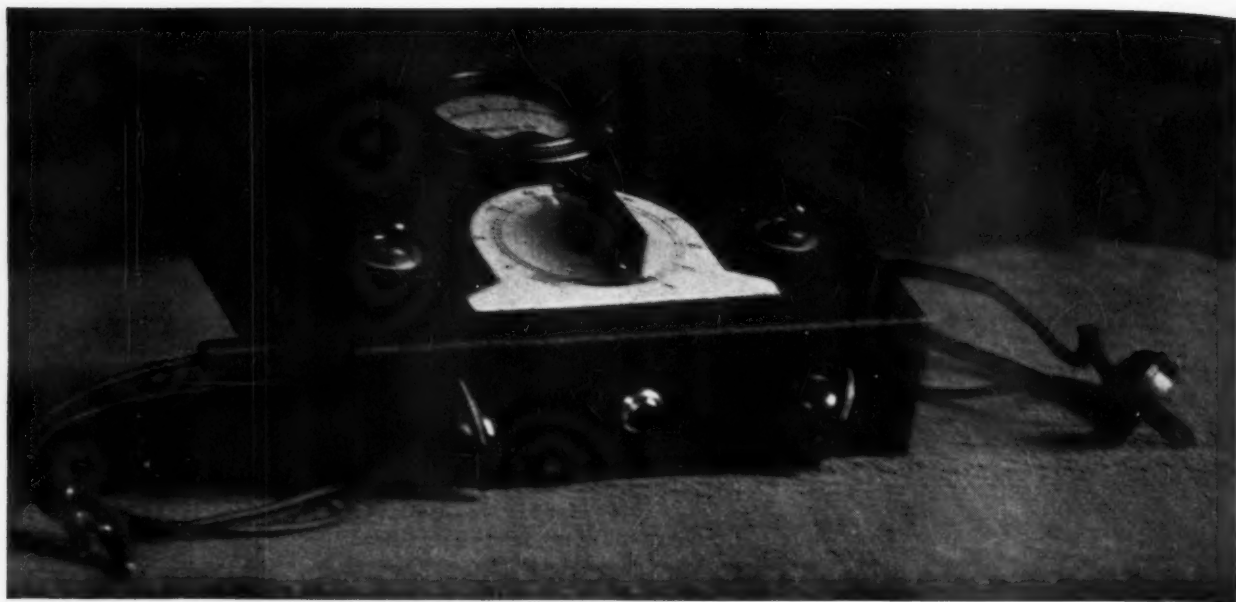
Captain William Baggaley
Commanding Officer of Noroton

standard objects of instruction, have been built by students.

Maintenance, inspection and repair constitute a very important phase of the materiel course. Typical trouble shooting examples are plotted in instruments. Probably one of the most unusual of these, for the beginner, is a breadboard receiver, with every item numbered. Students are asked to determine values as well as faults, which are deliberately spotted, and changed for each group of students.

In addition to the aural method of transmission courses, visual methods of transmission are also taught. These courses include the use of flags to transmit messages, and the use of blinkers and the blinker gun to send messages too. These form very important sections of the program of training, directly allied to methods of communication.

Probably one of the most interesting and vital sections of the training program, concerns the "on-the-ship"



The dial scale is hand-drawn on bristol board and cemented to the panel.

Compact Direct-Reading Z-Meter

by **RUFUS P. TURNER**

Consulting Engineer, RADIO NEWS

This instrument can be built from spare parts that most radio servicemen have on hand. It may be used for many applications

IMPEDANCE is a sizable bother to most servicemen and electronic hobbyists because it is a difficult quantity to determine. Suitable measuring instruments are costly and calculations are cumbersome. It will be good news to these workers that an instrument may be constructed from stray parts to show directly the impedance of coils, chokes, transformer windings, speakers, and the like; the inductance of iron-core coils; and the audio-frequency reactance of capacitors. This compact Z-meter is shown in the photographs.

The operating principle of the meter is explained quickly by reference to a classic electrical experiment: Figure 1 shows the circuit of a well-known lab-table setup for determining impedance. The coil, L , of unknown impedance (or capacitor of unknown reactance) is connected, as shown, in series with a calibrated variable resistor, R , and an alternating voltage of suitable frequency is applied across the series combination.

An alternating current, I , flows through L and R , this current being of the same value in both components, and produces voltage drops across the coil and the resistor. The coil drop will be equal to IZ (Z being the coil impedance in ohms), while the resis-

tor drop will be equal to IR . Bear in mind that I is the same in each case.

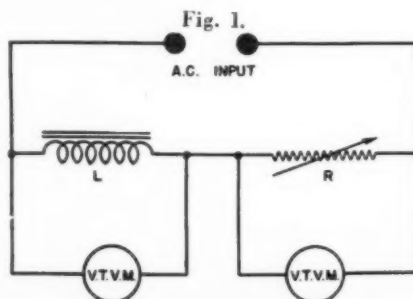
The values of voltage appearing across the coil and the resistor are indicated, as shown in Figure 1, by separate vacuum-tube voltmeters. The reading of each of these meters will be proportional to the impedance or resistance across which it is connected. If R exceeds Z , the right-hand meter will read highest, and vice versa. When R equals Z , the two meters will indicate identical values.

It is clear then that the variable resistor, R , may be adjusted in ohmage until the "resistor meter" reads the same voltage drop as the "coil meter," whereupon the value of resistance at that setting may be read directly as the impedance of the coil. For rapidity of reading, and other conveniences, the

resistor might be fitted with a dial graduated directly in ohms for direct reading.

The impedance-measuring circuit may be simplified further as shown in Figure 2, by eliminating one of the v. t. voltmeters and switching the remaining one successively across the coil and resistor. The unknown impedance would be connected to the terminals, $X-X$, and the alternating test voltage introduced through the terminals shown as a.c. input. Adjustment consists simply of throwing the meter switch back and forth, while at the same time varying the resistance until the meter reading no longer changes with the switch position. And at this point, the impedance of the test sample is read directly from the resistor dial.

The value of test voltage need only be sufficient to force enough current through the impedance and resistance in series to give voltage drops within the meter range. The frequency may be that of the power line or of some other value. While the line frequency will be entirely satisfactory for some impedance measurements, voice coils, output transformers, speaker windings, and other audio equipment must be measured at the standard frequency of 400 cycles. It might be desirable



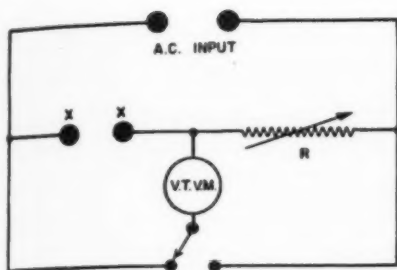


Fig. 2.

to make still other measurements at 1000 cycles. Consequently, an added improvement would be a means of switching-in a second test voltage of frequency other than that of the line, at the same time cutting out the line voltage automatically.

Features of the Z-Meter

The self-contained impedance meter shown in the photographs and diagrammed in Figure 3 embodies all of the features just described. Entirely self-contained, it affords measurements of Z-values between 20 and 10,000 ohms with internal 60-cycle test voltage or external a. f. voltage of any selected frequency. Impedance values are read directly in ohms on the single adjustment dial. In addition, a switch, S2, and a set of terminals, TV, and TV₂ (Figure 3), permit use of an external calibrated resistor when impedances outside of the 20-10,000 ohm range are to be measured or when it is desired to employ the more accurate lab decade box type of resistor.

A standard phone jack (J in Figure 3) is provided for injection of an external voltage of frequency higher or lower than 60 cycles. When the external-oscillator plug is inserted into this two-circuit jack, the internal 60-cycle test voltage is automatically interrupted.

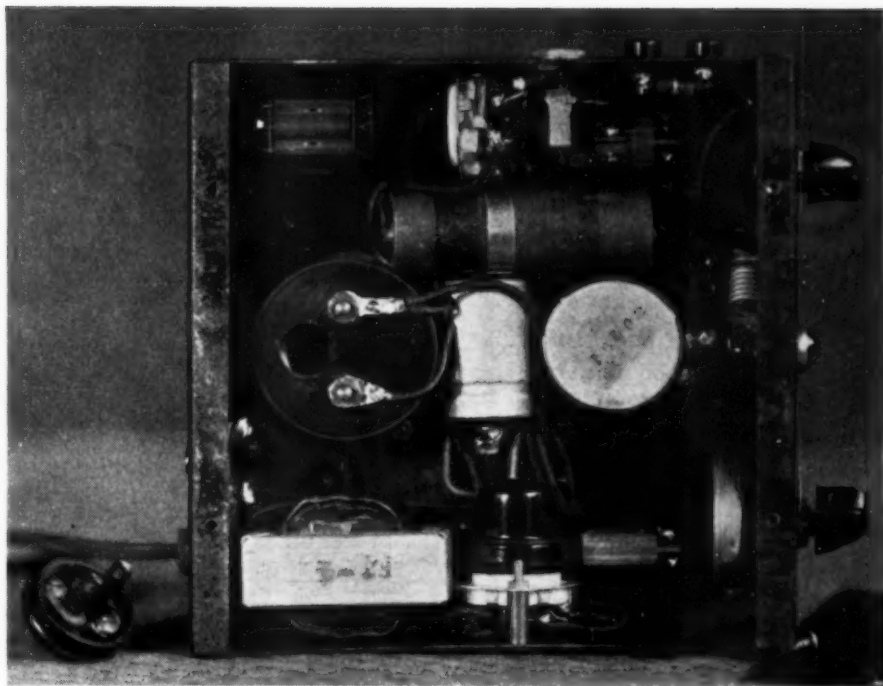
The self-contained vacuum-tube voltmeter is quite stable in operation, has a full-scale range of 0-4 volts RMS with a 1-megohm input resistance, and conveniently is made accessible for external use in any electronic voltmeter application. Although the scale of the instrument shown in the photographs has been graduated in RMS volts, the v. t. voltmeter is useful for electronic d.c. measurements as well, with a slightly different scale.

A power supply is built into the Z-meter, making the unit entirely self-contained. And although construction of the instrument may be considered crowded, the nature of the power supply is such that very little heat is occasioned by its presence in the close quarters.

Both the vacuum-tube voltmeter and its power supply are unique in design and merit a separate description.

Power Supply

In the design of compact a.c.-operated instruments, the self-contained power supply demands more than its rightful share of attention and offers plentiful headaches. This unit must not only be as small as physically



Underside view shows the position for mounting the 6H6 rectifier tube. It should not be mounted too close to the electrolytic condenser unit.

practicable, but it must generate the very minimum of heat and hum fields.

In laying out the Z-meter, our first temptation was to include an a.c.-d.c. type of power supply. However, that impulse was promptly disregarded, since one side of the test circuit (and perhaps the chassis as well) would be made "hot" by the line-operated rectifier. An isolating power transformer is imperative in all such instruments, but certainly not conducive to compressed construction.

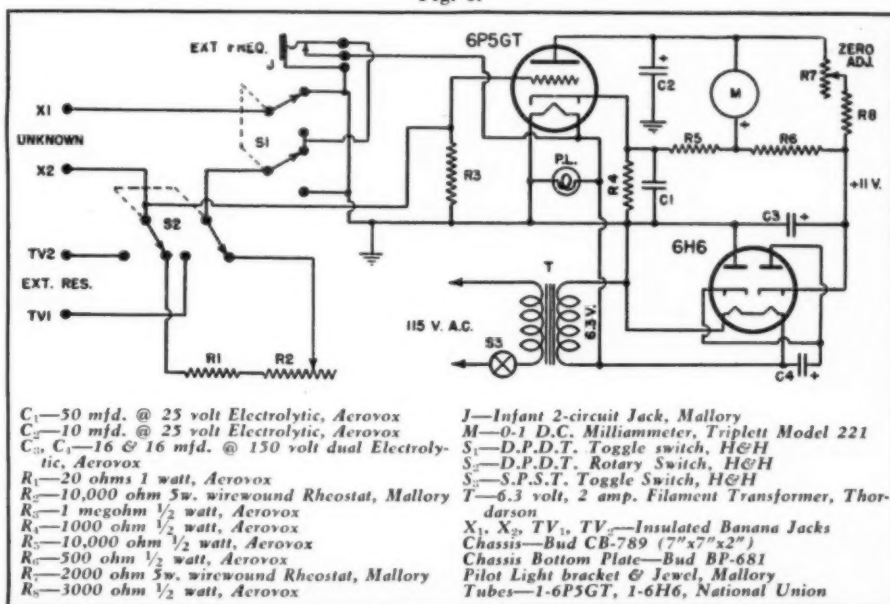
The dimensions of a common 6.3-volt filament transformer and a 6H6 rectifier tube are enticing, but the prospects are slim when it is considered that the pair, connected as a full-wave rectifier, affords only about 6 volts output. A higher output voltage is ob-

tained with a voltage doubler circuit, narrowing the problem down to finding a v. t. voltmeter tube which will operate at a plate voltage of approximately 12!

The writer found type 6P5-GT triode to perform efficiently as a v. t. voltmeter tube, at very low plate voltages, when connected as shown in Figure 3. This discovery made possible the use of the tiny filament transformer-6H6 voltage doubler power supply.

The power supply is shown in the lower half of the circuit in Figure 3. The power transformer, T, is a midget 6.3-volt filament transformer which does triple duty supplying plate voltage to the 6H6 doubler, heater voltage to both rectifier and v. t. v. m. tubes and pilot light, and 60-cycle test volt-

Fig. 3.



age to the unknown measuring circuit.

The circuit embracing the 6H6 and the two 16-mfd. electrolytic capacitors will be recognized as a conventional half-wave doubler. The d.c. output under full load is 11 volts. No filtration is necessary. Somewhat higher output and better voltage regulation might have been obtained by employing the full-wave doubler circuit. But the latter arrangement introduces a hum problem due to the nature of its B-minus return and at the same time necessitates a second transformer for the 60-cycle test voltage. Both regulation and output obtained with the half-wave circuit shown were found to be adequate for the Z-meter, so the circuit simplicity has been preserved and fullest use made of the small power transformer.

The power supply occupies only one corner of the instrument and the 6H6 tube generates only a small amount of heat.

The V. T. Voltmeter

The vacuum-tube voltmeter circuit is built around the 6P5-GT tube. (See Figure 3.) Fundamentally, this is a plate-rectification type v. t. v. m. operated at 11 plate volts and approximately 1 volt of fixed bias.

The indicating instrument is a O-1 d.c. milliammeter connected in a bridge circuit, embracing R5, R6, and R7-R8, one arm of which is the tube plate resistance. The variable portion (R7) of one arm enables the operator to balance out the steady no-signal plate current of the tube, thereby initially setting the meter to zero.

An a.c. input signal of 4 volts RMS is required for full-scale deflection of the milliammeter. Calibration is not linear, although very nearly so. A chart showing the voltage calibration of this v. t. voltmeter is given in Figure 4 for the benefit of those constructors who may not care to follow the writer's example of drawing a special voltage scale for the milliammeter.

The 1-megohm resistor, R3, maintains bias voltage on the 6P5-GT grid, preventing open-grid slamming of the meter when the arms of S1 are in transit.

When the Z-meter is in operation, the v. t. voltmeter is alternately con-

nected across the unknown coil or capacitor and the measuring resistor combination, R1-R2. Both grid and ground terminals are in the measuring circuit.

However, the v. t. voltmeter may be used also for external measurements of voltage at audio and radio frequencies. For this purpose, the grid and ground terminals are available through the same jacks (X1 and X2) to which the unknown coil or capacitor is normally connected. For this adaptation, S1 is thrown to the up position and an insulating plug, such as a short length of bakelite rod, inserted into the external frequency jack, J, to open its contacts. This causes the 60-cycle test voltage circuit to be opened through the jack and the v. t. v. m. grid to be connected directly to impedance jack X2, while ground is connected directly to impedance jack X1. Voltage test prods are then connected, "high" prod to X2 and "low" prod to X1.

Zero-drift in the v. t. voltmeter is surprisingly slight. The instrument has been operated over various test runs of several hours with little occasion to reset zero.

The v. t. voltmeter is equally useful at power-line, audio-, and radio-frequency voltages. It was checked against a high-grade commercial instrument at frequencies as high as 20 megacycles, a negative voltage error of less than one-tenth volt appearing in the vicinity of 20 mc. At least part of this slight error was due to length of the test leads. By keeping the input grid lead as short as practicable (by mounting the 6P5-GT socket so that its grid terminal is as close as possible to jack X2), radio-frequency errors may be reduced.

Mechanical and Electrical Construction

Due to the war-time shortage of small metal cabinets, the entire instrument is built on a small black wrinkle-finished steel chassis. This is a Bud CB-789 which is 7" x 7" x 2" in size. It is provided with a Bud BP-681 bottom plate. The chassis was found to provide such a perfect housing for the Z-meter, it being of neat proportions and small size, that we wondered why we ever considered a standard cabinet anyway.

One of the photographs shows the external view of the instrument. The small indicating meter, Triplett Model 221, occupies top center of the front (which is the chassis top). The special-drawn scale of this meter reads directly in RMS VOLTS. Directly below the meter, and likewise along the center line, is mounted the rheostat, R2, which is controlled by the long bar-knob seen in the photograph. The pointer of this knob travels around a direct-reading ohms scale drawn on white Bristol board which is covered by a sheet of transparent celluloid to prevent soiling. This is the main control of the instrument.

To the left of the ohms scale is the test switch, S1, and to the right of the scale is the line on-off switch, S3. From left to right along the front edge of the chassis are the finger-grip knob for S2, the pilot light jewel, and the finger-grip knob of the zero-set rheostat, R7.

Along the left edge of the chassis and toward the front are seen the jacks X1 and X2 (into which the test leads are inserted), and the miniature external frequency jack, J. The jacks TV₁ and TV₂ are not shown in the pictorials but may be placed on the same side as X1 and X2.

The line cord enters the instrument through a grommet-lined hole along the rear edge of the chassis.

The internal arrangement of parts is shown in another photograph. The power supply, consisting of filament transformer and 6H6 tube, is shown along the bottom. The 6P5-GT tube, with its socket bracket, is seen at top left. The milliammeter, capacitor C1, and main control R2 appear along the center line. The dual electrolytic capacitor, C3-C4, is bracket-mounted between the 6P5-GT and meter.

Calibration

The direct-indicating ohms scale and the v. t. v. m. scale are the only parts of the Z-meter requiring calibration. And, unless the operator intends to use the v. t. voltmeter externally for actual direct-indicated voltage measurements, there is no real need to alter the milliammeter scale. The Z-meter itself may be adjusted just as well with the mils scale as with a special voltage scale.

The plate for the ohms scale is cut from lightweight white Bristol board punched with a center hole for the rheostat bushing and is fastened to the instrument front by the rheostat mounting nut. A good-grade ohmmeter or resistance bridge is connected to the R1-R2 combination for calibration of the resistance. R2 is then set at its normal zero position (which is now not zero but 20 ohms, the resistance of R1). The resistance at that setting is checked by means of the ohmmeter or bridge and the actual ohmic value marked on the white scale.

R2 is then advanced successively to a number of other selected resistance points, the resistance closely checked at each of these points and marked on the scale. The writer's scale, shown in the photograph of the instrument, is marked at 20, 50, 100, 200, 300, 400, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, and 10,000 ohms. Intermediate graduations between most of these numbers show intermediate values of resistance.

After the markings have been completed, the scale is removed from the instrument, the lines and numbers inked in with black India ink, and the scale replaced—this time being topped with a protecting face of transparent celluloid. In replacing the scale, it is

(Continued on page 50)

Fig. 4.

VOLTS (RMS)	MILLIAMPERES
0.5	0.14
0.8	0.20
1.0	0.26
1.2	0.30
1.5	0.38
1.6	0.40
1.8	0.50
2.0	0.52
2.4	0.60
2.5	0.64
2.8	0.70
3.0	0.78
3.2	0.80
3.5	0.90
4.0	1.0

WELL paying jobs are open to qualified individuals, male or female, in the maintenance of radio sonde equipment. College training in mathematics and physics is essential. Due to the war, women are finding the employment possibilities increased as a result of the shortage of man power.

It is the purpose of this article to give a few facts concerning the equipment.

The accurate forecasting of the weather for a week or more is dependent upon the regular and accurate observation of conditions at high altitudes related to the air. These are: barometric pressure, temperature, humidity, wind direction, wind velocity.

For some years, the airplane was used more or less successfully for the purpose of checking the first three of the conditions, but wind velocity could only be checked roughly in a moving plane. In good weather and clear visibility, balloons can be sent up and their movement observed by means of surveying instruments, giving an accurate check on the wind velocity and wind direction. On days of poor visibility, the balloons are poor devices. Planes are also limited by weather and are costly to operate (about \$35 per flight). They seldom attain a height of more than 15,000 feet.

As a result of the above considerations, our government and foreign governments have conducted experiments with radio sonde equipment. Basically, each system is made up of a meterograph and radio transmitter built into a single case. The unit is carried up into the air at high altitudes, lifting power being provided by a balloon. At regular intervals of time, signals are sent out by the device and interpreted by an operator at the receiving station on the ground. Although no human is aboard the balloon, the device is almost human in its good response to weather conditions and the sending out of intelligence while in flight.

In clear weather, the balloon can be checked by using surveying instruments and in unclear weather it can be checked by using a radio direction finder to get its position.

The recently (comparatively) developed radio sonde of the U.S. Navy Department was designed by the Radio Section of the National Bureau of Standards. The writer had an opportunity to listen to a lecture at an I.R.E. meeting, delivered by Harry Diamond, Chief of the Radio Section, in which a practical demonstration was given of this equipment. The efficiency of the equipment is remarkable. It consists of a light weight radio transmitter operating on 50 megacycles and coupled to a doublet form of antenna, a compact meterograph to transmit weather data in connection with the radio and a balloon about 5 feet in diameter to carry the equipment high into the stratosphere or upper air region. At the ground station, a radio receiver operating on 50 mc. is used,

The Radio Sonde

by **WILLARD MOODY**

Radio Instructor

The essential parts of the radio sonde include radio transmitter, balloon, meterograph, etc.

in conjunction with suitable recording equipment. Radio direction finders are also employed to check on balloon position during flight, thus aiding in determination of wind direction and wind velocity.

As the balloon ascends into the air, the atmospheric pressure decreases. At sea level this pressure is about 16 lbs. per square inch and it decreases as the altitude increases. In the stratosphere the air becomes very thin and the pressure is very low.

This loss of air pressure is utilized to move a small switch contact in its relation to other contacts, in steps of a few hundred feet. For each unit rise in altitude there is a movement of one contact. This enables the operator on the ground to know when the radio sonde has gained altitude and how much it has gained. At the time a contact is made, a modulated carrier signal is sent out by the flying transmitter, having a predetermined modulation tone which identifies the signal. The contacts interspersed between those which identify pressure are humidity contacts wired to a potentiometer of ohmic value controlled by the change in the lengths of blonde human hairs which vary (in accordance with the humidity) in length.

A switch arm passing over the humidity contacts connects into the circuit the humidity potentiometer, causing a signal to be sent out by the transmitter. This signal has an audio frequency modulation proportional to the potentiometer setting. The audio tone thus indicates the relative humidity

when the balloon is in flight, and as the humidity changes, the tone also changes.

When the switch arm passes over the insulation between the contacts, the audio frequency is set by a gadget consisting of a small glass tube filled with sulphuric acid. The resistance of the acid volume changes with temperature and consequently the change in resistance, change in audio tone, permit judging the temperature of the air by means of the received signal at the ground station.

Automatic receiving and recording equipment is used to plot the information received. A mechanical pen writes on a graph and gives a continuous curve, the pen being controlled by radio.

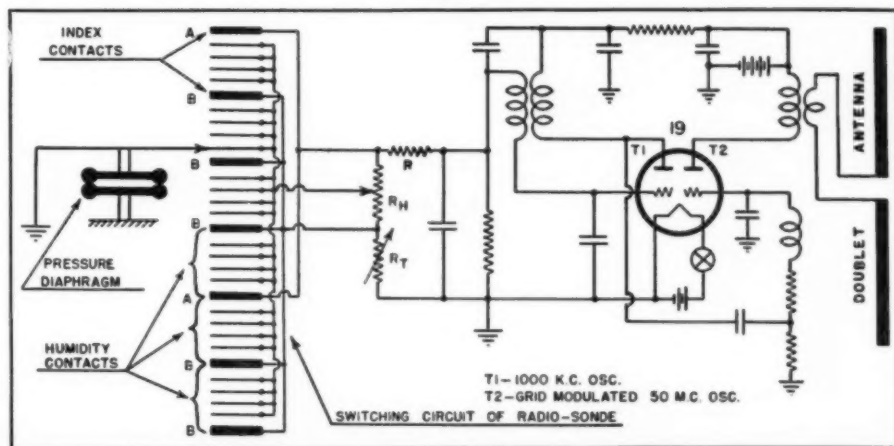
The pen setting is determined by demodulation of the signal, varying according to the frequency of the audio note. The final result is that complete information on the condition of the atmosphere is gained, which is invaluable in predicting the weather.

A typical radio sonde unit is shown in Fig. 1. One triode section serves as grid-leak condenser form of modulated oscillator, generating a frequency of 1,000 kilocycles and blocking automatically at an audio frequency rate. Varying the value of grid circuit resistance changes the time constant of the R-C combination and hence the triggering or blocking frequency rate changes.

This variation extends from zero to about 500 cycles. The output of the

(Continued on page 43)

Fig. 1.





Everything may be carried in two portable cases—including new discs.

A VERSATILE RECORDER for MILITARY and CIVILIAN USE

by **OLIVER READ**

Managing Editor, RADIO NEWS

This portable recorder draws a total of but 70 watts and is capable of high-quality cutting. Ideal for military application.

RECENT rulings have made it practically impossible to obtain the so-called semi-professional type of recording assemblies. However, there are many types of turntable assemblies still available, and it is possible to use one of these as a basic unit for a home-built recorder assembly.

There has been a rather heavy demand for a compact portable recording assembly which could be set up to operate either from conventional supply lines or from a 6 volt storage battery for field or emergency operation.

Our military machine makes thousands of records daily, either to intercept foreign communiques or as morale builders for men in our fighting forces. In many cases, the conventional 110 v. supply lines are not readily available, and for that reason, the entire equipment to be described was designed with the matter of economy well to the top of the list of requirements, which had to be met in order

to make the recorder versatile as well as practical.

The results of the design of the unit showed that not only was it well adapted to the recording of voice transmissions, but the fidelity indicated that here was an ideal recorder for more exacting requirements of music recording and reproduction. Consequently certain refinements were added in order to make the unit as flexible as possible and yet not to increase the weight materially nor the physical size.

The Recorder

A search was made for a table which possessed the necessary inherent stability and finesse so important to quality cutting. Most of the units examined were rather bulky and had considerable weight. The final selection was a Presto model 9C assembly, together with its compact leatherette-covered portable case. The original unit was equipped with a magnetic

type cutter head and a magnetic producer of limited range. We decided to increase the range of both the cutter and pickup, and consequently made two alterations. First, the cutter proper was replaced with a *Brush RC20* crystal head and the pickup was replaced with a *Brush PL25* high fidelity crystal head and arm. This extended the range to include at least 10,000 cycles, which was not possible with the original equipment.

Details of the mounting arrangement for the cutter are shown on page 15. Note that the cutter arm has been left in its original form. This arm is extremely sturdy, and the accuracy of the gear teeth leaves little to be desired. The particular method of feed employed is the so-called "under-drive."

It was necessary to file away about $\frac{1}{2}$ " of the metal on top and at the end of the cutter arm, so that the new assembly could be slipped into the U shaped portion remaining, with the

cutting stylus coming into the proper arc with respect to the hub of the table.

The original feed lever was retained. A small bracket was formed from $\frac{1}{16}$ " aluminum, bent as shown, and into this bracket was mounted securely the crystal cutter. The new assembly was inserted into the U, and carefully aligned both vertically and horizontally, so that the plane of the bottom edge of the cutter is directly horizontal to the surface of the disc, and has a space of approximately $\frac{1}{8}$ " between the cutter and the disc after the stylus comes to rest on the surface of the disc.

One problem remained; i.e., the means for adjusting the tension or, in other words, the depth of cut. This was accomplished by making up a simple bracket as shown and by employing a threaded bolt with head removed and placed with the drilled hole on one end, together with a knurled knob, so that the spring tension could either be increased or decreased, depending upon requirements.

The original recorder mechanism was designed to cut 120 grooves-per-inch, either inside-out or outside-in, depending upon which worm gear was employed. This means that 15 minutes per side of recording is had with a $13\frac{1}{4}$ " disc or approximately 13 minutes per side with a 12" disc. In the long run, this economy is well appreciated. Furthermore it means that complete programs of 15 or 30 minute duration may be recorded on one disc. The average home recordist, for example, is limited to the purchase of one machine only. Therefore, it is necessary to "flop" the record at the middle of a half hour program. Most commercials take place during this interval and that is the opportune moment for flopping the platter, as little of the program itself will be missed, if any.

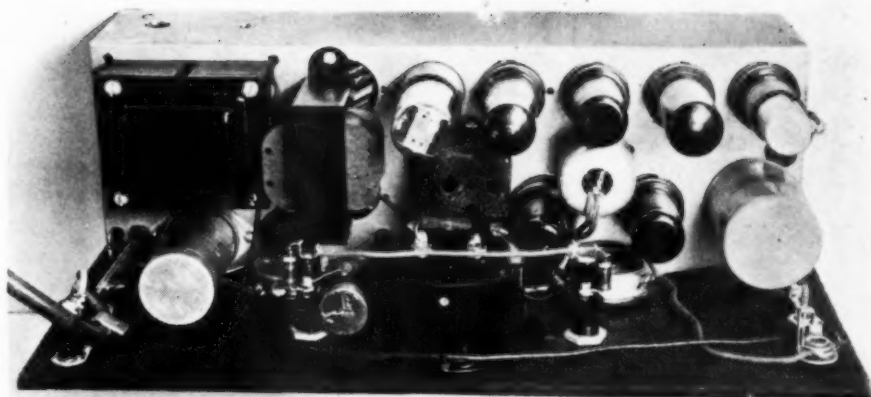
We have found it entirely unnecessary to remove the threads or scrap from the first side when going through this change-over. Simply pick up the disc, turn it over rapidly, and reset the cutter arm. The scrap can be removed upon completion of the entire disc.

A sapphire stylus is the logical choice when using high grade equipment, particularly when cutting at slow speeds and where maximum economy is desired from the equipment.

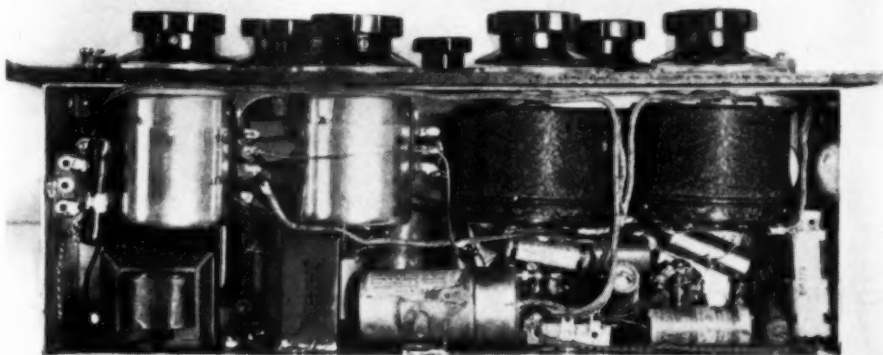
We have experienced no difficulty or loss of efficiency in using high grade sapphires for periods of better than 50 hours cutting time. One word of caution: Insert the stylus into a small cork when the equipment is packed to prevent damage to the delicate point. This precaution may very well mean the saving of a \$6.00 investment.

Pickup Assembly

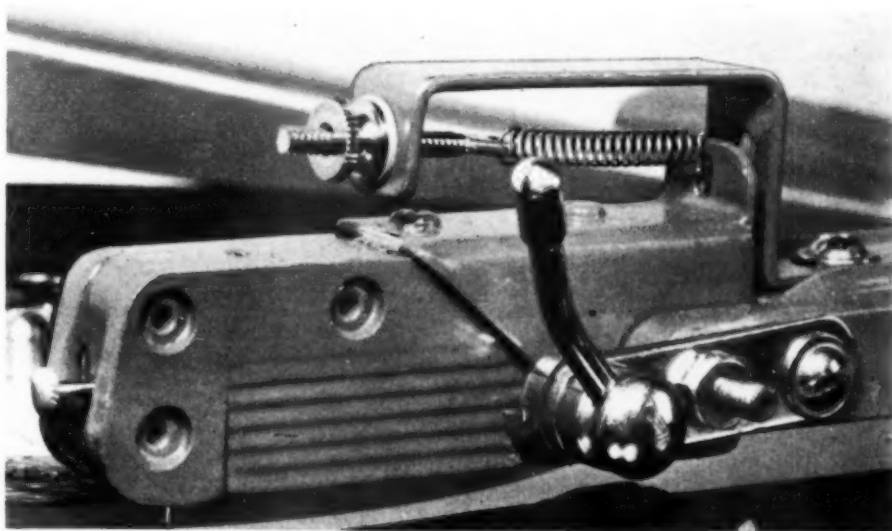
One problem presented itself after the selection of the PL25 pickup. The counter-weight projected out from the cabinet, so that closing of the lid was impossible. The solution was to cut a



Above: Mounting positions for all tubes are indicated. Panel is of Masonite.



Above: Left-to-right, Master gain, Pickup, Mike No. 1 and Mike No. 2, controls.



Above: Bracket details for mounting the cutter. Note vertical adjustment.

strip of $\frac{1}{8}$ " steel approximately 4" long. One end was fastened securely to the pickup base. The other terminates at a bolt which is so positioned that the pickup may be swung either to or away from the direction of the center of the turntable. In other words, the distance becomes variable and when the equipment is packed, the pickup is swung towards the table where it will clear the closed lid.

A shielded cable and associated connector may be seen on the illustrations. Likewise shielded cable for the cutter and the line cord and plug are connected to the receptacle provided for on the amplifier panel.

In order to utilize all available space, we found that we were able to store 15 or 20, 12" blanks within the cover of the case. This was done by inserting a $\frac{1}{4}$ " carriage bolt through

be needed. These had to be of low impedance types, so that they could be used many hundreds or even thousands of feet from the amplifier proper. High impedance microphones are not well suited for this application as is commonly known.

2. Gain controls must be of high grade, so that no circuit noise will be introduced.

3. High grade crystal pickups require plenty of overall gain. Therefore an extra stage was needed to compensate for their low output.

4. A calibrated Master gain control was needed in order that the amplifier could be used for special application, where it was necessary to determine loss in terms of DB.

5. Bass and treble equalizers were needed in order to adjust the response curve to that which would afford the proper reproduction for various types of recording and playback.

6. The use of an output pentode with inverse feedback was the logical choice in order to obtain sufficient power without drawing too heavily from the power supply.

7. A switching arrangement would be needed so that the crystal cutter would receive proper load, and at the same time could be monitored visually without upsetting the output circuit.

8. Provision for a high impedance headphone for monitoring when using microphones, and where it is necessary to observe the quality of the program.

All of these problems were met and the final result is indicated by referring to the schematic diagram.

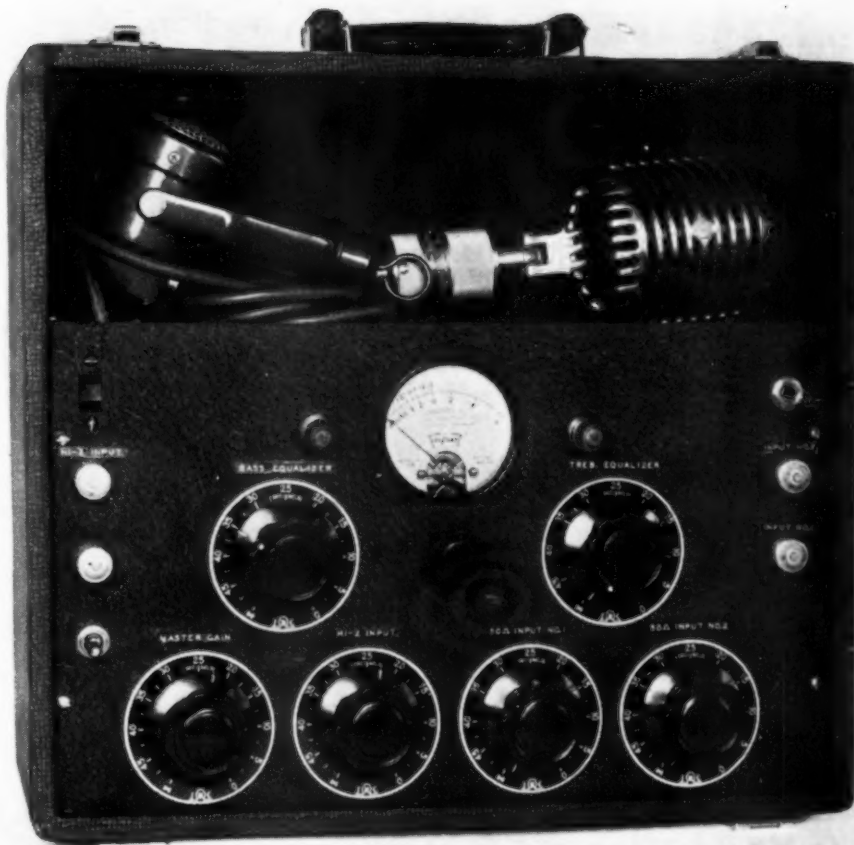
The tube lineup is as follows:

A 6SJ7 preamplifier, 6N7 electronic mixer, 6C5 electronic equalizer stage, 6C5 driver, 6C5 pickup voltage amplifier, 6V6 output, and a 5W4GT rectifier.

All of the resistors were noise-tested before being wired into the circuit. This precaution is well worth the added effort, and very often they make a difference between a good and a mediocre amplifier.

Each of the two microphones, viz., Shure Unidyne and Turner No. 199, has an impedance of 50 ohms. The two T pads, R1 and R2, are connected in parallel to the primary of T1. The resulting impedance is 25 ohms, and even though the transformer does not have this particular selection, the input may well be 50 ohms with no noticeable change, either in gain or fidelity.

It is extremely important that a well shielded high quality transformer be used when feeding low level mikes into a high gain amplifier grid, as there is every tendency to pick up hum in this circuit. Shielding must be very completely carried out to the grid and plate leads of the 6SJ7, as well as the grid and plate leads coming from the 6C5 pickup voltage amplifier tube. Failure to observe this precaution will result in a considerable amount of residual hum picked up from a.c. fields within the vicinity of the transformer,



Mikes and cables are carried in the compartment above the amplifier unit. Incoming cables are kept clear of the various gain and equalizer controls.

fil. leads and the pre-amplifier tubes.

A 6N7 is used as an electronic mixer, as being the type best suited to the purpose. It is capable of amplifying high level signals without introducing serious distortion. While it would have been much simpler to use a series type mixer, nevertheless, the use of a dual triode eliminates cross talk, and is, therefore, recommended.

Equalizer Network

A very effective filter may be wired into the grid circuit of a triode such as a 6C5 as shown. It is possible by its use to give boost to either bass or treble frequencies, or both, and thus produce a curve similar to that of commercial orthocoustic characteristics. This is highly desirable, as it gives control of the treble frequencies when cutting discs and allows the bass to be brought up for reproduction. When the two controls are shorted out, i.e., when R18 and R19 are in "off" position, the response of the amplifier will be substantially flat. These two parts should preferably have a linear taper, although a logarithmic taper will be satisfactory. There is little, if any, gain from this stage, and therefore, additional amplification is required.

The output transformer matches a 5,000 ohm load to voice coil of 4 ohms. When the switch 2 is in the play-back position, the secondary connects directly to the speaker voice coil. In the other position, the output of the

6V6 terminates to the resistor network used in connection with the crystal cutter. The values of C29, 30, 33 and 35 will determine the turnover frequency of the cutter response.

In past articles, we have discussed *constant amplitude vs. constant velocity* recording. The combination of resistors mentioned above are required when cutting the latter. For *constant amplitude*, other components and values would be required. These are included with the RC20 cutter and will not be covered in this article.

The output meter is required in order to determine the cutting level. The cutter requires an average of 100 volts for full modulation of the groove. A standard DB meter was on hand with a basic range of -10, +6 DB. It was calibrated for a 500 ohm line. When used across the 4 ohm line, considerably more power may be fed to the meter. We found that the addition of R32 would give us a maximum reading of 100 volts when the meter indicated +6 DB. Inasmuch as the secondary of T2 is lightly loaded during cutting, there will be little reaction back to the primary and the added meter will not upset the characteristics required by the cutter.

Further protection is afforded by the use of two small neon lamps wired in as shown. If excessive voltage appears across this network, the neon gas will ignite and there will be an immediate reaction and tendency for

(Continued on page 56)

Induction-Controlled Systems

by WILBERT T. PETERSON

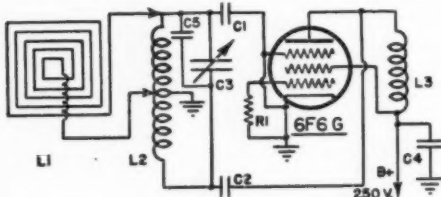
Here are several more circuits and discussions of Induction systems for control of models and for short range code or voice transmission.

THE purpose of this article is to relate the experiences encountered with induction transmitting and receiving circuits both for control and communication purposes.

For the benefit of those who are not acquainted with the subject, a brief review of the principles of induction transmission will be presented.

Instead of utilizing the radiation properties of an antenna or similar radiator coupled to a radio frequency oscillator, the induction field surrounding the radiator is used as the communicating medium.

This induction field exists around



C₁—0.005 mfd. mica cond., Sprague
C₂—0.002 mfd. mica cond., Sprague
C₃—0.001 mfd. padding cond., Meissner
C₄—1 mfd. @ 400 v. cond., Sprague
C₅—0.006 mfd. mica cond., Sprague
R₁—10,000 ohm 1/2 w. res., Centralab
L₁—20 turns No. 22 D.C.C. 18" sq. loop
L₂—140 turns No. 22 P.E. close wound on 4" diam. form
L₃—85 mh. choke, Meissner
Tube: 1—6F6G, National Union

Fig. 1. A 50 kc. Induction Transmitter.

any conductor or radiator properly excited with alternating potential. It can be detected easily in the immediate vicinity of the conductor, however, it diminishes rapidly as the distance between such a conductor and measuring device is increased.

For this reason induction control systems can only be used satisfactorily when the distance between the generator and receiving device is short.

The main object for using an induction control system, of course, is to have a means of overcoming distance with electro-magnetic energy without radiation. This is unusual since the overcoming of distance has always been associated with the radiation phenomena of an electro-magnetic wave. In fact, the greater the radiation we could attain from generator and associated radiator, the easier it became to overcome distance.

There are several good reasons, however, as to why the radiation properties of an electro-magnetic wave are currently being ignored. The most important reason as far as the amateurs

are concerned, is that the radiation phenomena of electro-magnetic energy of the higher radio frequencies is a bit too successful in its purpose of overcoming distance.

For this reason in induction transmission we shun the radiation field by employing very low radio frequencies, using low power for our induction generators, and coupling them to loop antenna systems.

By using the low radio frequencies between 50 to 500 kc., the antenna or radiator must be of comparatively large dimensions in order to provide an efficient radiation field. In induction transmission, however, a loop or the generator tank coil itself is used to propagate the wave into space resulting in an extremely inefficient radiation field. Low power is used because the distances covered for induction systems are small, and power output is rather unimportant.

The Federal Communications Commission has authorized this type of radio transmission without requiring a government license only when the following condition is strictly adhered to. The signal strength of an induction transmitter must not exceed 15 microvolts per meter at the distance of the wavelength of the transmitter divided by 2π . This ratio immediately

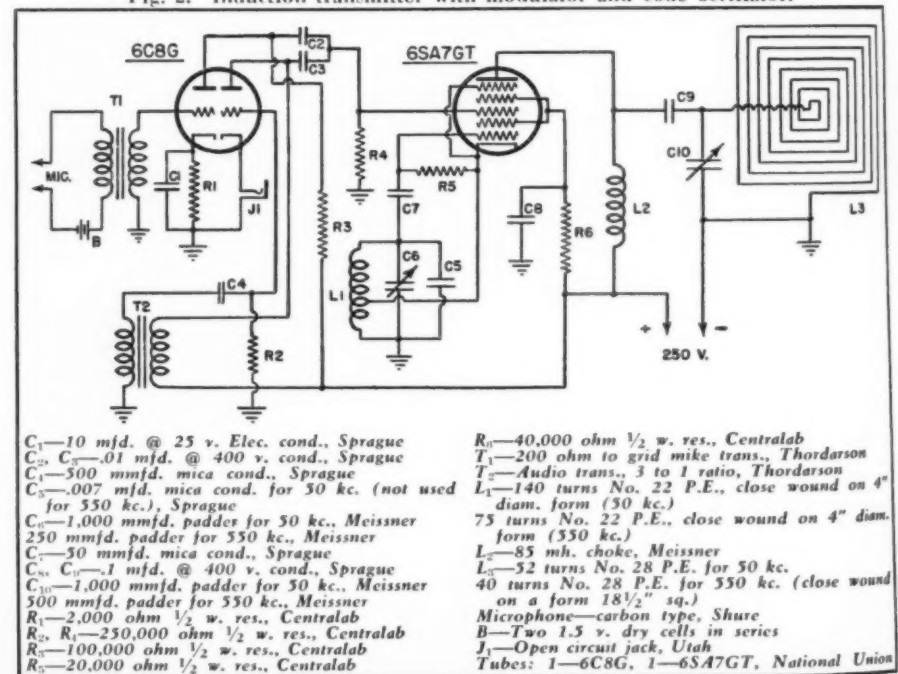
tells us that the higher in wavelength we operate an induction system, the greater the distance we can utilize a 15 μ v. signal. As an example when operating at 400 kc. or 750 meters, the distance we can place a 15 μ v. signal is 119 meters whereas at 50 kc. or 6000 meters, it is 955 meters.

Types of Circuits

In designing an induction system whether for control or communication, the first thing to measure is the maximum distance at which the transmitter and receiver must work together. After converting this distance to meters, the formula $\lambda = 2\pi D$ (λ = wavelength in meters, D = distance in meters) is used to determine the wavelength with which we can utilize the 15 μ v. signal and still remain within the F.C.C. rulings. It is not absolutely necessary to use this particular wavelength for the distance specified, however, the difference being that if a lower wavelength is used, the 15 μ v. per meter maximum would be exceeded, and if a higher wavelength is used more power will be needed at the transmitter or larger loop circuits built for efficient operation.

As in all types of radio design work, a compromise must be made in this case between the amount of power

Fig. 2. Induction transmitter with modulator and code oscillator.



C₁—10 mfd. @ 25 v. Elec. cond., Sprague
C₂—0.01 mfd. @ 400 v. cond., Sprague
C₃—500 mmfd. mica cond., Sprague
C₄—0.007 mfd. mica cond. for 50 kc. (not used for 550 kc.), Sprague
C₅—1,000 mmfd. padder for 50 kc., Meissner
C₆—250 mmfd. padder for 550 kc., Meissner
C₇—50 mmfd. mica cond., Sprague
C₈—C₉—1 mfd. @ 400 v. cond., Sprague
C₁₀—1,000 mmfd. padder for 50 kc., Meissner
R₁—2,000 ohm 1/2 w. res., Centralab
R₂—R₃—250,000 ohm 1/2 w. res., Centralab
R₄—100,000 ohm 1/2 w. res., Centralab
R₅—20,000 ohm 1/2 w. res., Centralab
R₆—40,000 ohm 1/2 w. res., Centralab
T₁—200 ohm to grid mike trans., Thordarson
T₂—Audio trans., 3 to 1 ratio, Thordarson
L₁—140 turns No. 22 P.E., close wound on 4" diam. form (50 kc.)
L₂—75 turns No. 22 P.E., close wound on 4" diam. form (550 kc.)
L₃—85 mh. choke, Meissner
L₄—52 turns No. 28 P.E. for 50 kc., 40 turns No. 28 P.E. for 550 kc. (close wound on a form 18 1/2" sq.)
Microphone—carbon type, Shure
B—Two 1.5 v. dry cells in series
J₁—Open circuit jack, Utah
Tubes: 1—6C8G, 1—6SA7GT, National Union

used in the transmitter and the physical dimensions of the loop or coil circuits. Experience has shown it is practical to use the wavelength specified in the above formula. It must be remembered that induction circuits are only practical at short distances and the greater the distance which we may attempt to cover, the larger must be the physical dimensions of our loop or radiating system. This is due to the important fact that the signal pickup of the receiving loop decreases considerably as the wavelength is raised. For all practical purposes, the wavelength chosen should be the lowest possible for the distance involved in which a 15 μ v. signal can be used.

Transmitter circuits for induction control or communication are usually simple affairs consisting of one-tube oscillators with perhaps another tube as speech amplifier and modulator. The Hartley or electron-coupled oscillator works equally as well with either triode or pentode tubes. The tank coils usually are of high inductance with many turns, resulting in a low Q unless heavier wire is used. No. 22 enamel seems to be practical for most tank circuits with No. 28 for the receiver loop circuits. The tank circuit condenser has rather large capacitance, and the variable tank padder must be shunted with silver mica fixed condensers when working at the lowest frequencies.

Power supplies for the transmitter can either be the conventional a.c. power supply with rectifier and filter for permanent systems, or battery or vibrator type supplies for portable arrangements. When working at the lower frequencies it is again necessary to use vibrator type supplies for portable transmitters in order to secure the higher voltages necessary economically.

The receiver circuits are a bit more complex, however, the old TRF circuit is used exclusively. There would be no advantage in using a superhet

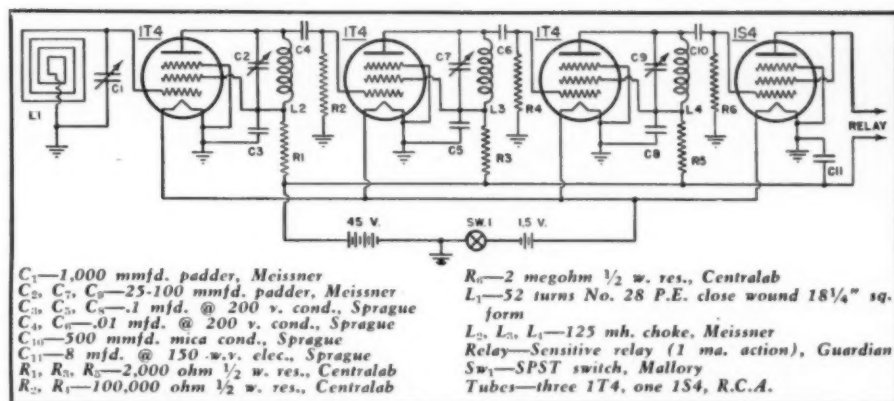


Fig. 4. A 50 kc. receiver designed especially for relay control.

circuit because of the low frequencies involved, and selectivity becomes no problem whatsoever. Impedance coupling must be used for the lower frequencies, the impedance consisting of a choke coil and padder in parallel, connected across the plate circuits of the r.f. tubes. Since no i.f. coils are available for frequencies below 100 kc. these coils must be home-made affairs. The receiver must have a rather high sensitivity, at least three stages of r.f. must be employed. The detector may be either the standard diode circuit or for a slight increase in sensitivity, a grid leak condenser type may be employed.

In induction communication systems, the usual audio system prevails in the receiver, and in induction control systems, a sensitive relay is inserted in the detector plate circuit. A loop antenna is usually used, however, in permanent locations the inverted L or doublet antenna may be used. Power supplies are the same as in the transmitter depending on whether the unit is used permanently in a fixed location or for portable use. The most economical arrangement is to use the same power supply for both receiver and transmitter with a switchover arrangement for transmit or receive.

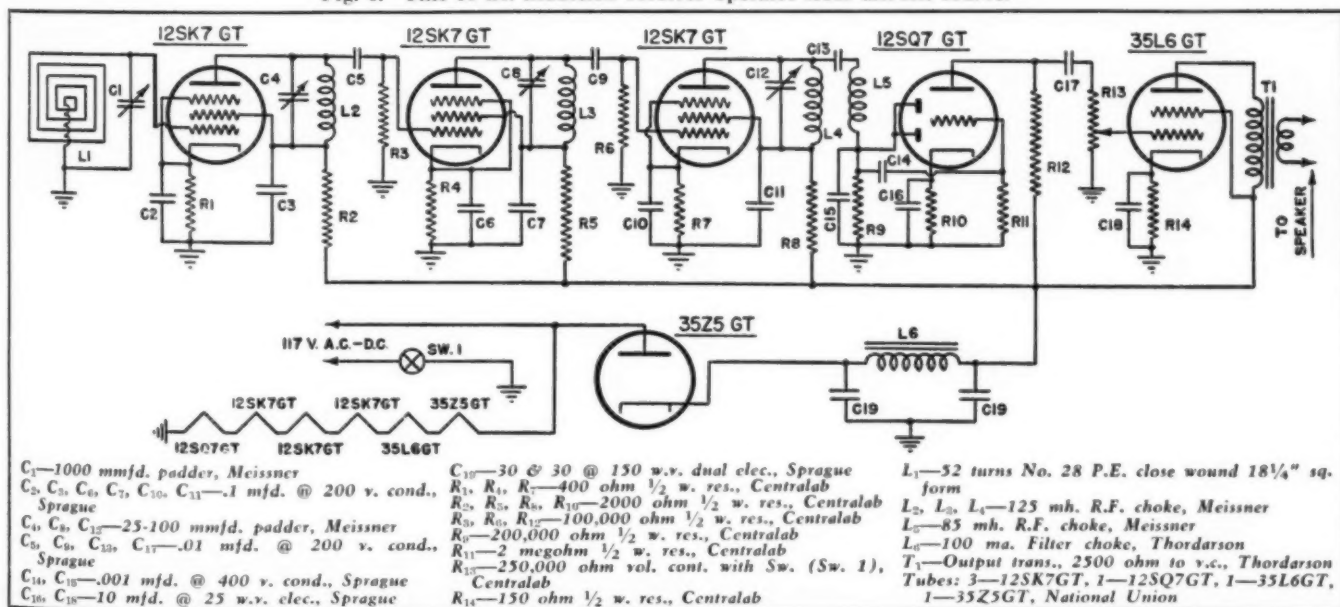
Transmitter Design

In considering the design of a 50 kc. transmitter for induction control purposes where no modulation is required, there is only one main obstacle to overcome and that is to secure a radiator or loop of sufficient size to provide a usable induction field. In referring to Figure 1, the loop antenna described will provide a fair induction field, however, at these extremely low radio frequencies, the loop should be of considerable larger physical dimensions. The circuit described will provide a usable field. However, a sensitive receiver with a longer antenna should be used for reception. It may be worth mentioning here that there is plenty of opportunity for ambitious radio experimenters to design efficient radiating loops for this frequency in order to make use of the maximum distance allowed for the operation of induction systems.

The oscillators used at 50 kc. are usually very stable and are simple to construct. The shunt or series fed Hartley requires only a single winding tank coil and works out very well. The circuit described in Fig. 1 is a shunt-fed Hartley circuit. The tank coil consists of a 4" bakelite form, close-

(Continued on page 58)

Fig. 3. This 50 kc. induction receiver operates from a.c.-d.c. source.



Radio Coat for Fighting Men

by S. R. WINTERS

The Radio Coat is more than a novelty. It may be developed into a formidable weapon for fighting men. Radio circuits are withheld.

A COMPLETE radio broadcasting and receiving station quilted into a coat is the invention of a Chicago man—Berkey E. Cover, Sr. By uplifting the left arm, the wearer of this unique radio garment may conduct a two-way conversation, thus becoming a walking-talking broadcasting station. Self-contained, the unit includes microphone, receiver, transmitter, earphones, upright antenna, and batteries (the latter being carried in the pocket).

Other than a novelty, this radio coat enables soldiers to communicate with each other, and their commanding officers; or sailors may converse with one another on different ships. Firemen can send and receive instructions while combating widespread conflagrations in city buildings; policemen on their beats may receive flashes from headquarters and report riots.

This ultra-modern coat is made of water-, weather- and fireproof fabric. It is insulated with asbestos or another non-conducting material, when worn in summer or in the tropics. With a microphone mounted on the cuff of one sleeve of the coat, the earphones or headphones stitched into the collar of the garment—and the batteries inserted in the pockets—the complete ensemble, when worn, makes a man appear as an inhabitant of Mars or just lost from the dramatic pages of an Orson Welles. The upright antenna contributes further weirdness to the picture, the aerial appearing as isolated as a single, burnt-over tree after a forest fire.

The collar of the coat, with which is associated the earphones or headset, is sufficiently wide to project up over the ears when it is turned up. The pockets, having inclined slits or openings in the garment, are of ample width and depth to accommodate the batteries and other transmitting and receiving units. These pockets are supported from the belt, which is placed between the lining and outer material of the coat and is sewed at the inside or otherwise secured in position. This belt, in reality, is a flat tube and takes the form of a small tunnel, which is lined with metallic fiber or asbestos. Through this belt or flat tube run the insulated wires as conductors of the radio circuit. It includes a branch tube which extends into the left-hand coat sleeve for per-

manent or detachable connections with a transmitter or microphone. The latter may be raised freely to the mouth for speaking into when sending verbal instructions. Another branch of the main tube or belt leads to the collar in the back of the left-hand sleeve, branching off at the neck for connections with a cross-piece on the collar, having upright portions to connect with the earphones or headset when the collar is turned up.

The entire equipment is compact and light in weight and, according to the inventor, the wearer may walk with an unchallenged movement, although the upright, telescopic antenna rod rears itself uncomfortably close to the side of one's head.

Referring to the drawings, and outlining constructional details of this garment, the coat has the usual back portion, left-front flap, and right-front flap—to overlap and to be buttoned or otherwise secured in a closed position. The microphone may be stitched permanently on the sleeve or detachably mounted in an opening in the sleeve, with a protecting flap, as illustrated in one of the diagrams. Similarly, the earphones or headset may be mounted in a secure position, with or without a detachable plug and socket connections for associating the conductors therewith. The earphones may also be connected by an electric or flexible band which fits over the head as an additional support for the parts in conjunction with the collar when turned up, as illustrated in Figure 3 and Figure 4.

The back of the coat—in the rear of the pocket and under the sleeve—is provided with a mounting flange or insulated bushing, supporting a spring socket in an upright position. This socket has a contact in the bottom, connected to one of the conductors, thus lending itself to support, detachably, an upright aerial or rod, similar to radio antennae on automobiles. This rod is of the telescopic type, built in sections, telescoping one within the other. When attached to the radio coat, this antenna rears itself upward at the back of the wearer and at one side of the head, approximately at the shoulder, so as to restrict the free movements of a person as little as possible. If desired, an eyelet (as shown in Figure 1) may receive this aerial for securing it against the garment.

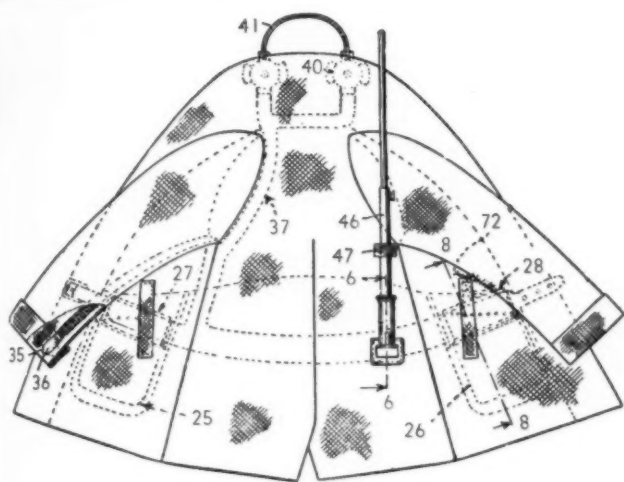
The stitching of the belt or flat metallic tube is illustrated in the sketches, although this conduit may be mounted in other positions or between the garment's lining—either secured permanently or detachably. The diagram, Fig. 7, shows the device as being of identical construction, although the apparatus is mounted detachably in position by spaced-ball and socket fasteners or snaps. The snaps are placed in the cloth of the coat and the ball heads, to engage the snaps, are mounted on the conduit. This is not necessarily an arbitrary arrangement, as other suitable means may be afforded for securing the conduit and other parts, detachably, within the radio garment.

The wiring diagrams illustrate a battery having one cell provided with a terminal (51) and other cells having additional terminals (52 and 53) the terminal 51 being part of the receiving circuit and the terminal 52 being a common return. The terminal 53 is identified with a cell of the battery for supplying the necessary power for transmitting purposes. Ordinary single plug and socket connections, or other terminals may be provided for making the usual electrical connections of the conductors (54, 55, and 56), respectively, with the terminals (51, 52 and 53). A conductor (57) leads from the contact (45) of the antenna to the aerial connection (58) on the transmitter and receiver (28). Other terminals (59, 60, and 61) have the conductors (62, 63 and 64) lead from the microphone (36) to the terminals (65, 66, and 67). Conductors (68 and 69) lead from terminals (70 and 71) to the earphones (40).

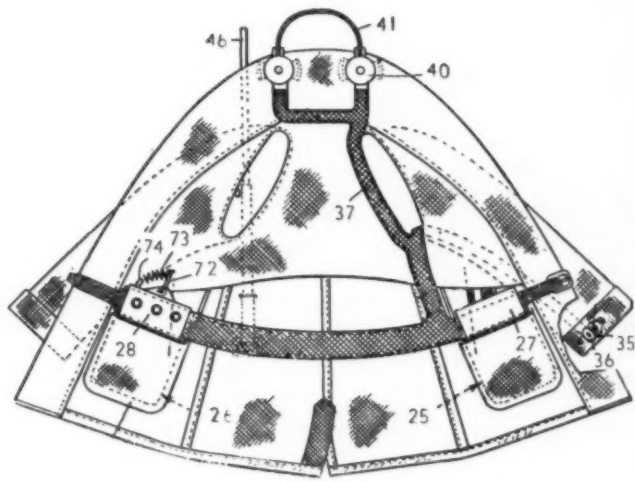
A switch, actuated by a spring and normally set for receiving purposes, is mounted on the transmitting and receiving unit. When the latter is pressed against the action of the above spring, the transmitter is placed in position to send signals, by use of a microphone (shown in Fig. 4), when the left arm is raised, almost automatically, so that the microphone is placed before the mouth.

The receiving position, when employing this radio garment, is illustrated in Figure 3. The transmitter-receiver unit is equipped with a stop for the switch, or the former may be an integral portion of the switch, such

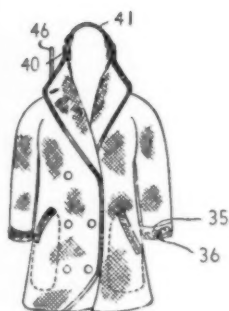
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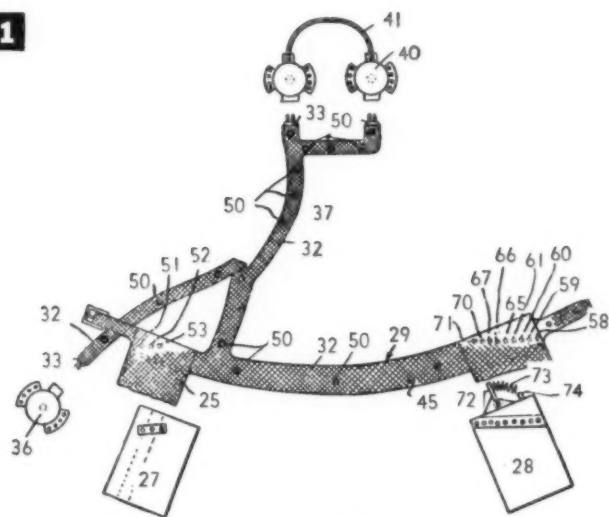
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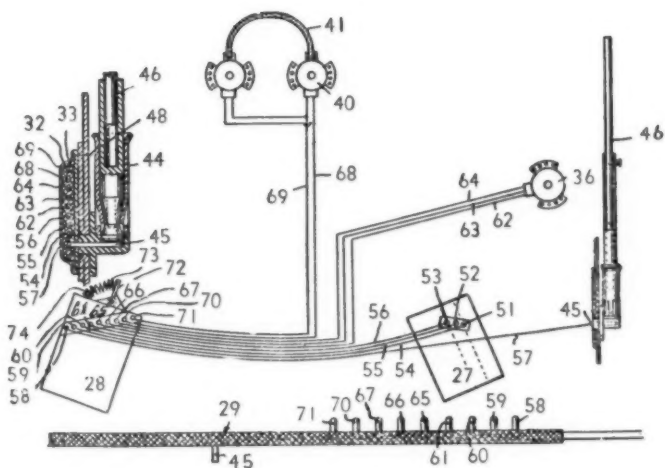
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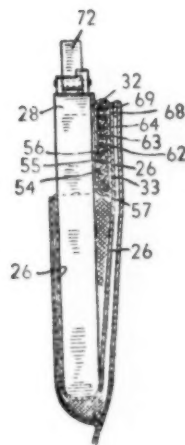
7



4



5



6

Details of the radio coat, taken from the original patent papers.

6-6—Sectional view shown in Fig. 5
8-8—Sectional view shown in Fig. 6
25—Pocket for battery
26—Pocket for radio equipment
27—Battery
28—Transmitter and receiver
29—Belt
32—Metallic tubing
33—Extension tube
35—Hole in sleeve for microphone connection
36—Microphone

37—Conduit
40—Head-phones
41—Head-phone band support
44—Socket antenna
45—Antenna socket contact
46—Antenna
47—Additional eyelet (antenna support)
50—Ball head for engaging snaps
51—Battery wire to receiver
52—Common battery wire
53—Battery wire to transmitter

54, 55, 56—Battery lead wire
57—Antenna wire
58—Antenna terminal on transmitter and receiver
59, 60, 61, 63, 66, 67—Binding post
62, 63, 64—Microphone wires
68, 69—Head-phone wires
70, 71—Terminals for head-phones
72—Switch spring
73—Spring
74—Switch stop

FM METAL-TREASURE LOCATOR

by G. M. BETTIS

ONE of the most frequent applications for specialized radio equipment is its use in exploring Mother Earth for metallic objects, such as precious metals, hidden water pipes, etc. This is not a new application in any sense of the word, and radio has been used for many such purposes. Many pieces of apparatus have been publicized, and some have worked extremely well. Others failed in their mission to discover these hidden treasures, inasmuch as their ability was limited, and it was not possible to detect metallic objects for more than a few inches when hidden beneath the surface of the ground.

Considerable experimental work has been done in order to improve upon existing methods. One such method is described and illustrated in this article. It is known as an F.M. Locator.

The introduction of frequency-modulation has afforded the experimenter a new opportunity in the advancement of this science, inasmuch as he practically has an entirely new theory upon which to base his experiments. This locator is an experimental version, and is by no means the ultimate, as far as being able to locate metal is concerned. It is offered to those who get real pleasure and satisfaction by applying the principles set forth and by conducting their work in such a manner that they will in time not only improve upon the efficiency of the unit, but also to receive additional knowledge on the characteristics of F.M. in general.

We mentioned above that this is an *experimental* piece of equipment, and while it works very well, we feel that we could have improved upon it, if we had had proper laboratory equipment for checking our results. We have had considerable experience with amplitude-modulated locators, not only from the development standpoint, but from actual operation in the field.

Circuit Design

In order to reduce the overall weight of the combined units, we decided to use the new miniature tubes which have standard 1.5 v. filaments in transmitter and receiver.

The transmitter proper consists of a 1G6GT audio oscillator tube, which we use as a modulator; a 1N5GT in the reactance stage; a 1A5GT as an electron-coupled oscillator, which works on 1.5 megacycles; and a 1Q5GT as double-amplifier operating at 3 megacycles.

The receiver uses 3 miniature type tubes in the TRF stages; a 1N5GT serves as the demodulator and meter indicator stage; two 1S5 tubes are used in the discriminator stage (the pentode section of one serves as an

audio amplifier); and a 1S4 for power output stage.

No 1.5 volt tube was available having similar characteristics to that of the 6H6, and it was necessary to use two of the 1S5 type tubes in connection with a separate 1.5 volt battery to supply current to one of the 1S5 types in order to complete the discriminator stage.

The 1N5GT was given preference for use in the demodulator stage because of its sharp, cut-off characteristics. The operating frequency of this F.M. locator is 3 megacycles. This may be considered a rather high frequency for metal locators, and in fact is a rather unusually low frequency for

F.M. However, this frequency is very stable, as used in this F.M. locator. In contrast, an A.M. locator operating at such a frequency is inherently unstable. Another reason for the choice of 3 megacycles was that the lowest frequency that could be covered by the IF transformers reached this particular limit. It is very important to have a highly stable piece of equipment if satisfactory results are to be had.

Cases and Chassis

The cases are made of white pine. The joints of the cases are held with glue. Each case has a sliding door at the back.

The loop antenna is to be wound

This new application for FM offers a chance to engage in some experimental work on basic units.



The correct position for the locator is shown. Both aural and visual indication is had by using meter and headphones.

with 4 turns No. 18 D.S.C. center-tapped. The transmitter loop is pivoted around the bottom of loop frame by using two machine screws through the sides of the case. Coil springs are used between loop frame and case. A 6-32 brass rod, 3½" long, with a small knob soldered to the front end, mounts to the top of the loop frame and protrudes from the top front panel. This knob is used to pivot loop. The loop of the receiver is held with four wood screws and does not hinge as the transmitter loop. Both loops are mounted ¼" inside of groove for the sliding doors.

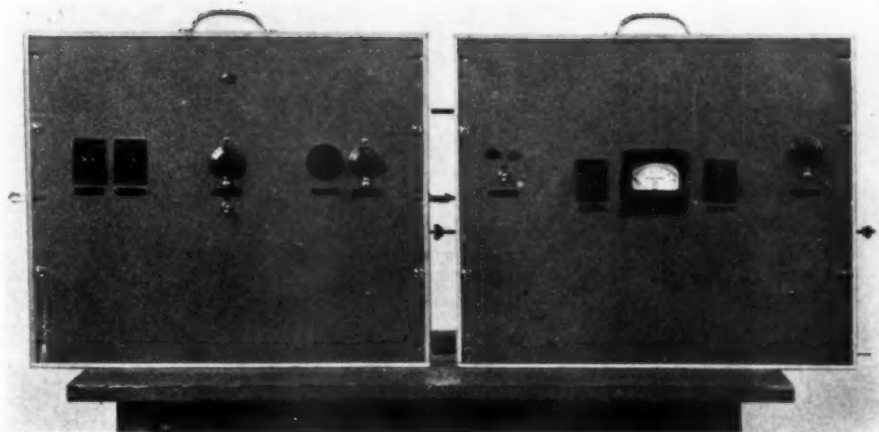
The detail of the chassis with measurements for making a drilling template to drill and punch the PA-988 panels are shown in Figs. 3 and 4. These panels are first drilled and punched—then bends are made.

The front panels of the transmitter and receiver are drilled to match the front part of the chassis. The panels are fastened to the cases with oval head wood screws and cup washers.

Receiver

The chassis will be assembled with reference to Fig. 3, by putting the 54-7P sockets in ⅝" holes where 1T4 type tubes are to be used and 78-7P sockets in other ⅝" holes; a MIP8 socket with 11-3K cushion is mounted in a 1½" hole; from the back the green, black, and red 78-1S sockets are mounted in ⅝" holes at end of chassis to take 70-1S matching plugs that are soldered to leads of receiver loop; the bias cell holder is mounted at other end of chassis to front part with flat head machine screws counter-sunk; the 20140 midget condenser is mounted to front part of chassis in same manner; the three BL-3M and a BL-3D wide band IF transformers are put in place.

Now fasten the chassis to PM-1596



The two-unit locator is housed in identical carrying cases. Note the indicating meter. This is positioned to be in direct view for operator.

by mounting D-13-139 controls with DP-982 dial plates in ⅝" holes on each side of meter hole; No. 521 tip jacks in ⅝" holes; SW-1119 switch with SW-1036 plate in ½" hole; place 10007 dial on 20140 condenser shaft and mount 10050 dial lock in ⅝" hole; and the 0-100 d.c. microammeter meter in 2⅝" hole. The name plates are mounted on front panel in their respective places.

With the assembly complete the wiring of receiver as shown in Fig. 2 is the next step. The Miniature tube sockets and soldering lug wiring should be free and no stiff connections made. This caution will save some Miniature tubes. Be sure to note the wiring of the first 1S5 Miniature tube as there is a separate "A" battery and only the diode part of this tube is used. All wiring should be carefully checked and be sure the sockets of the Miniature tubes are connected properly before any tubes are put in sockets.

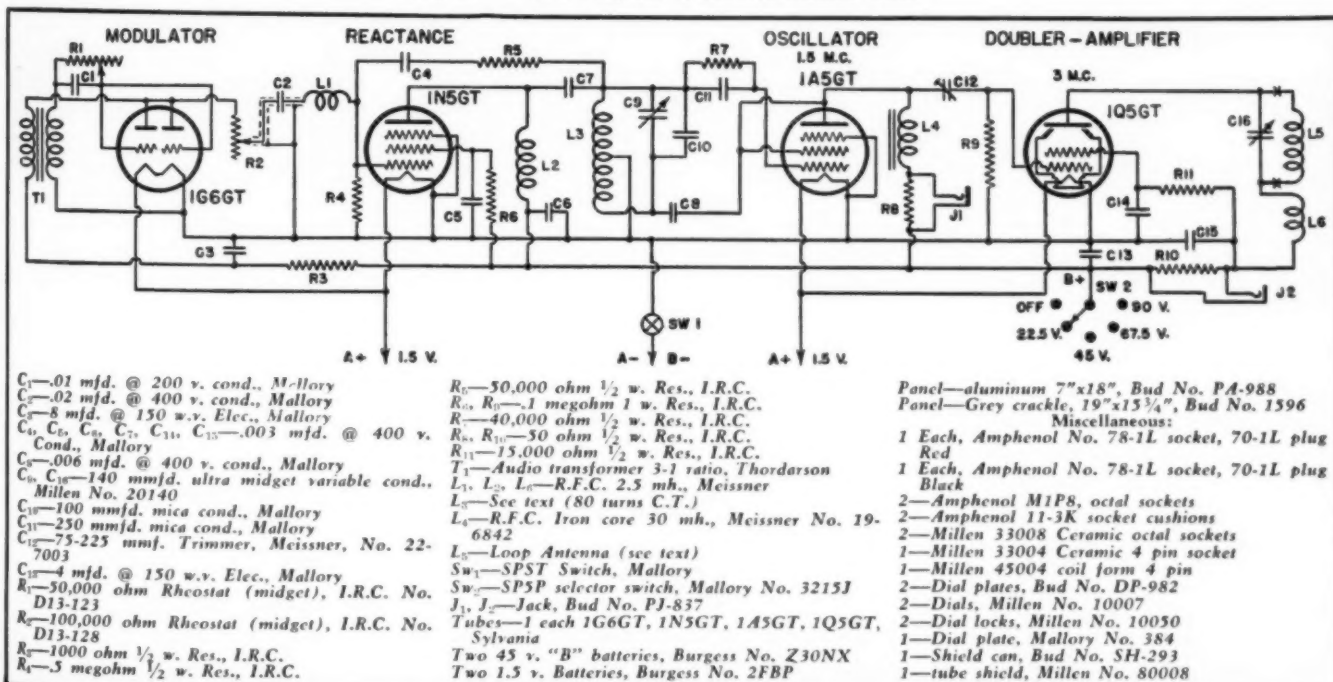
With tubes and bias cells in place and batteries connected the receiver is ready to test and is also ready for alignment providing everything checks as it should.

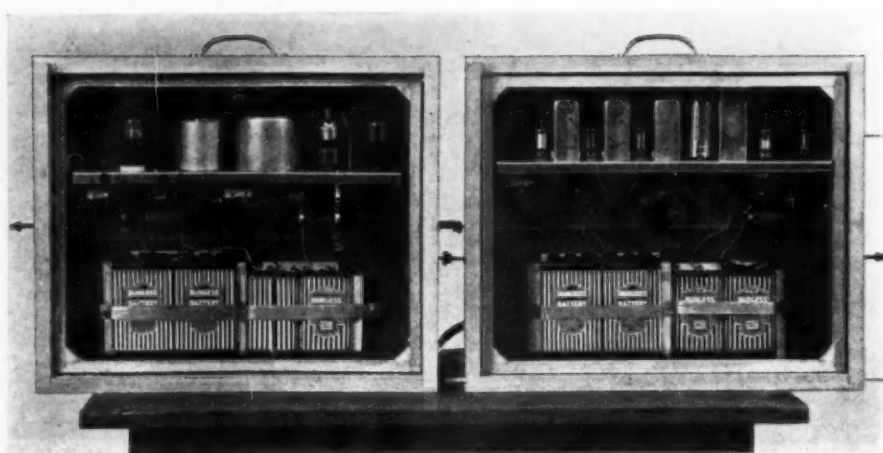
Alignment—To align the discriminator stage use a VTVM connected between points A and G. Feed a 3 megacycle signal into grid of demodulator tube (the limiter of a FM broadcast receiver).

Set secondary trimmer of BL-3D for zero voltage between points A and G. Change signal frequency from 2,950 to 3,050 kc. alternately, keeping signal input voltage constant. Adjust primary trimmer until equal voltages of opposite polarity are developed between points A and G. Readjust secondary trimmer to obtain zero voltage between points A and G when signal frequency is 3 mc.

The meter in the receiver is used to align the BL-3M transformers. Feed a 3 mc. signal into the grid of the first tube. Adjust trimmers as if

(Fig. 1) Circuit Diagram of the Transmitter Unit.





Each battery is tied down securely. Note neatness of construction.

aligning standard IF channels. Tune for maximum current indication. Listen in headphones and do not set meter control so the set will regenerate as this will cause the meter to draw too much current. This job of alignment can be properly done by a radio serviceman and proper alignment is very important for good results.

The receiver panel is ready to place in case and fix glue blocks to hold batteries in place for permanent connection. Plug in the loop and adjust condenser 20140. The only other adjustment will be condenser 20140 when the transmitter is finished and of course the gain and meter controls.

Transmitter

The chassis of the transmitter will be assembled with reference to Fig. 4, by putting MIP8 sockets with 11-3K cushions in the two $1\frac{1}{2}$ " holes at left; 33004 socket in center $1\frac{1}{2}$ " hole; 33008 sockets in other two $1\frac{1}{2}$ " holes; 78-1L sockets in $\frac{3}{8}$ " holes at end of chassis

to take 70-1L plugs on loop; PJ-837 jacks in $\frac{3}{8}$ " holes on back flange of chassis; two 20140 condensers in center and right front of chassis with countersunk flat head machine screws; and audio transformer in same manner.

Now fasten PA-988 transmitter chassis to PM-1596 front panel, by mounting D13-123 control with DP-982 dial plate in $\frac{3}{8}$ " holes at left; D13-128 control with DP-982 dial plate in next $\frac{3}{8}$ " hole; SPST switch in $\frac{1}{2}$ " hole in center; place 10007 dials on condenser 20140 shafts; 10050 locks in $\frac{3}{16}$ " holes; 3215J switch with 384 dial plate in $\frac{3}{8}$ " hole between condensers; attach knobs to control and switch shafts; to complete assembly put name plates in their respective places.

The transmitter is wired as shown in Fig. 1. The loop is wound with 5 turns of No. 18 DSC wire and held in place with coil dope. Both the receiver and transmitter loops should be wound on wood frames made as large

as possible to mount in the rear of their respective cabinets, approximately 17" x 14".

The oscillator coil is wound with No. 30 DSC wire on 45004 coil form with 80 turns close wound tapped at the center and doped. The oscillator coil is shielded with SH-293 shield can. The oscillator tube is also shielded with 80008 round shield. The modulator and reactance as well as the demodulator tubes are also shielded.

With the wiring finished the oscillator 1A5GT tube is plugged in and transmitter placed close to a receiver or a signal tracer is used and the oscillator tuned to 1500 kc. A milliammeter is connected in plate circuit jacks of both oscillator and amplifier in tuning the transmitter. The amplifier-doubler tube is plugged in and tuned to 3 mc. Proper adjustment of condenser C12 of Fig. 1 will be necessary for maximum output of transmitter.

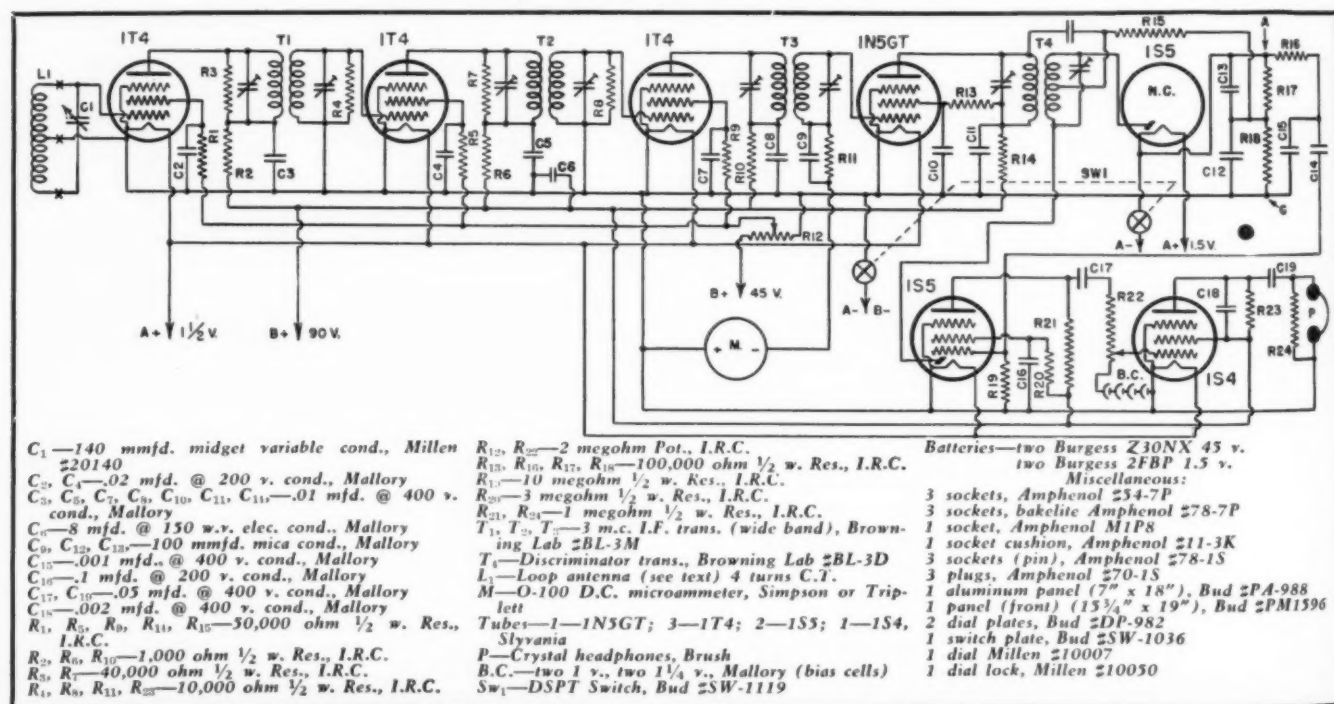
The oscillator and amplifier will be readjusted for maximum signal strength on meter of the FM receiver of this Locator. Adjust condenser 20140 of receiver for maximum signal in this alignment of the two units. Now the reactance 1N5GT tube and modulator 1G6GT tube are ready to plug in and adjustment of the tone, modulator, and volume or power controls of transmitter will be necessary to produce a strong signal in the receiver.

The Z3ON and 2FBP batteries should be firmly held in place by glue blocks and small metal strips and screws in both the transmitter and receiver.

With the two units complete and working efficiently, which can be tested by moving them apart and turn-

(Continued on page 57)

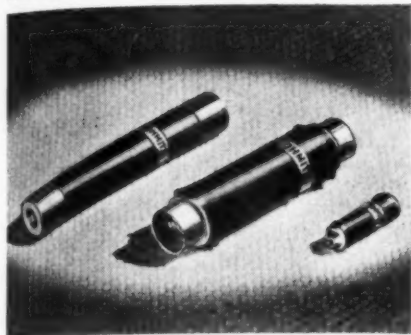
Fig. 2—Circuit of the receiver section.



WHAT'S NEW IN RADIO

Ohmite Ferrule Resistors

The Ohmite ferrule resistor has been designed for easy interchangeability without the use of tools. An even winding of resistance wire on a ceramic core is protected by an Ohmite vitreous enamel coating. The wire is



terminated on metal bands or ferrules which permit mounting in fuse clips. Ferrules are cup, sleeve, or cartridge type.

Special ceramic cores are available which, with special coating, will withstand the temperature shock test of repeated immersions alternately from ice cold water to hot water. Protective coatings which pass salt water immersion tests are also available.

The ferrule type of resistor is particularly applicable for use in the Navy, in the Signal Corps, on Army aircraft and on railroads. Units can be supplied in accordance with Navy specifications. Wide range of sizes.

For details write to Ohmite Manufacturing Company, 4835 Flournoy Street, Department 5M, Chicago, Illinois.

Sprague Dry Electrolytics Replace Aluminum Can Types

Not a substitute, but a specially built tubular cardboard dry electrolytic, the new Sprague Type WR Wet Replacement Capacitors are especially constructed for use in place of wet electrolytics which, due to their aluminum thread-neck cans, are unobtainable because of war restrictions. They also replace various aluminum can type dry electrolytics, now no longer available.

Although standard dry electrolytic condensers can sometimes be used as wet replacements, the safety margin is likely to be insufficient in many applications. Hence, Sprague Type WR's have a much higher voltage formation than standard dries to insure them standing up under the high peak voltages which are impressed on wet electrolytics. Also, they're built to handle the AC ripples that might cause standard 450 volt dry electrolytics to overheat to a point where they break down.

The diameter of WR's is the same as that of standard wets so they will fit the screw-type can mounting holes. Their metal feet can then be soldered to the chassis for firm mounting.

Sprague Type WR's are now available in three sizes, WR-8 which replaces wet or dry electrolytics in capacities from 4 to 8 mfd.; WR-16 which replaces capacities from 12 to 18 mfd.; and WR-25 which replaces capacities from 20 to 40 mfd. These new units are now being featured by Sprague jobbers. Descriptive literature will gladly be sent upon request to Sprague Products Company, North Adams, Mass.

New Ghirardi Book Display

A striking new improved "silent salesman" display for Ghirardi books compels attention by its patriotic color scheme and exhortations to "Train Yourself—Help Your Country—Learn Radio Quickly!"

Designed for more convenient examination of Ghirardi books and literature, this handsome stand embodies many sales-boosting features that merit its prominent display on every retail counter.

Larger pockets for an ample supply of circulars cut down the necessity of frequent refillings. Circulars stand erect, a new pocket arrangement banishing the unsightly nuisance of circulars flopping forward.

The convenient reading rack below the three Ghirardi's books urges the prospect to "Examine Them Here." The books themselves are safely at-



tached to the display by silk covered wire cords and, when standing in place, tilt slightly into the display for improved visibility.

Red, white and blue lettering, with a durable finish of light blue washable lacquer, achieve an eye-stopping effect

that focuses attention on the attractive display and invites examination of books and literature alike.

These valuable silent salesmen are available to all jobbers stocking Radio & Technical Publishing Co.'s books, 45 Astor Place, N.Y.C.

New RCP Electronic Limit Bridge

Highly accurate resistance measurements can now be made speedily with a new Electronic Limit Bridge announced by Radio City Products Co.



and designated as RCP Model No. 670.

This fine precision instrument is a boon to many industrial plants whose requirements are for rapid testing within narrow tolerances. A direct reading is given of the percent deviation, in either plus or minus direction, of resistance values compared to any predetermined standard.

The dial of RCP Model No. 670 is calibrated from zero center to ten percent deviation on either side. With each main division on the dial indicating one-half of one percent, fractional divisions showing deviations of one-tenth of one percent can be read quickly and easily, and approvals or rejections promptly determined.

Comparison is made against a predetermined internal standard of any arbitrary value selected. While this is supplied as part of the bridge, provision is also made for using any other value of resistance desired by switching to "External Standard" and connecting the new standard value to the corresponding terminals.

Component resistors are accurate to one-tenth of one percent and the indicating meter is a 4½-inch galvanometer having a sensitivity of 25-0-25 microamperes.

RCP Model No. 670 is battery operated.
(Continued on page 54)

AVIATION RADIO COURSE

by PAUL W. KARROL

Radio communications protects the pilot both at the takeoff as well as during the landing procedure.

AT numerous airports throughout the nation, aircraft of every description daily take-off and land systematically without accident. Over our airplanes gigantic airliners fly safely and quickly to their destinations carrying mail, express, and passengers. Our military and naval aircraft are constantly shuttling back and forth between stations and patrol areas, flying on certain air routes known only to those directly concerned with the coordinated movement of aircraft. Training planes containing embryo and advanced students who are becoming more proficient with each flight continually take-off and land at certain training fields. For the number of aircraft in the air at any given time on any given day, there are relatively few accidents. Now the question arises, "How is all this movement of aircraft controlled?"

Teletype net-works, wire intercommunication (interphone) systems, control tower radio systems, marker beacon and radio range facilities, and commercial radio systems, all play important parts in affecting coordinated air traffic control. (By coordinated air traffic control is meant the systematic dispatching of scheduled and non-scheduled aircraft, the pre-flight assignment of specific air routes to be flown at certain altitudes, the routing of aircraft in flight around bad weather areas, and the methodical instruction of pilots who are about to land and take-off.)

Much credit must be given our airlines and governmental agencies such as the CAA and naval and military air forces for their contributions to better and safer flying by perfecting and assisting in the perfection of certain radio aids to air navigation which have many times proven their worth. The United States Weather Bureau in cooperation with our airlines, CAA, etc., must also be commended for the fine service rendered during the past ten years. For without the aid of those just mentioned, modern day cross-country flying would not be what it is today.

Prior to a flight, the pilot obtains what is known as a "flight plan." This plan written out for him by the airport dispatcher (after contacting the airways traffic control station) contains all the information he will need for his flight. He will be told what routes to take, what altitude he should fly at, the weather along his course and destination, the wind direction and velocity at certain altitudes at certain points along his main course and any

additional information which he may desire.

After warming his plane up on the apron (mat extending from hangar to runways) he calls the control tower by radio for a clearance to take-off and instructions pertinent to the runway he should use, etc. The control tower operator will then make a careful but quick check on aircraft flying in his control area, contact the pilot, give him wind direction and allow him to take-off.

All the while the pilot is taking off and for some distance away from the airport (usually six to eight miles) he will keep his receiver tuned to the control tower until it is time for him to tune his receiver to the radio range station he will approach first. All along his flight route he will keep in touch at regular intervals with CAA ground stations and advise them of his position and his estimated time of arrival over a given station. If the weather changes at points along his course he will be given this information on his contacts and can be directed if necessary, out of stormy

areas, thus saving much time and possible trouble. Upon arriving at his destination he will call the control tower (usually fifteen minutes out) and ask for landing instructions. The control tower makes another check on local flying aircraft or approaching aircraft and issues his instructions. After landing, the pilot may receive additional instructions relative to the point to which he should taxi his aircraft. We can readily call a flight in which two-way radio is used as described above, a "radio directed flight."

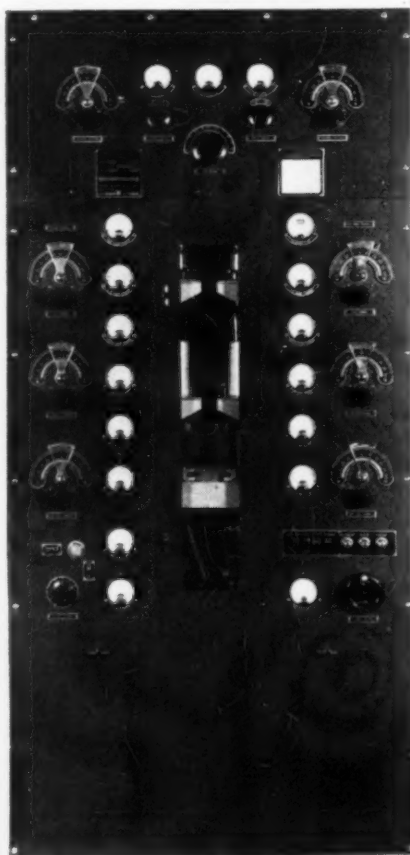
All the while the pilot is in the air, many things are happening on the ground which concern him. His departure is teletyped to stations on his course, who check on weather conditions and other aircraft. If radical changes in the weather occur, this information is then given immediately to the pilot via radio. If other aircraft are flying on or near his course he is also advised. Unless messages are of an urgent nature (classified) most of the flight information is given to the pilot on schedule.

Airway traffic control stations (the nerve centers of the traffic control systems) keep accurate check on all aircraft in the air, thus assuring free movement of all aircraft and "scattered arrival." The latter is achieved by dispatching aircraft at intervals distant enough so that aircraft bound for the same destination do not arrive at exactly the same time. The need for coordinated air traffic control can be readily seen when it is realized that many aircraft are sometimes in the air, on the same courses at the same time flying in conditions of poor visibility. Without coordinated traffic control, collisions would result and airport traffic control facilities would be taxed by the arrival of too many aircraft at one given time.

When a large number of aircraft desire to land at an airport, the control tower operator must assign each aircraft a certain altitude and require each to circle the field until called and given specific landing instructions. Where the weather is "closing in" fast, the control tower operator must work quickly and carefully. If there are aircraft not equipped with radio among those who wish to land and the "light" or "traffic gun" must be used, two operators must be used to effectively control traffic.

The light gun is capable of throwing three beams, viz., white, red, and green. When the red beam is given the pilot, it is the signal for him to taxi back to the apron or for him to

Radio Receptor SMRA Transmitter.



stay in his present position or for an aircraft in flight to circle the field. If the green light is flashed, the pilot may take-off or land. The white light is the signal for the pilot to taxi to the take-off strip. In cases where the control tower transmitter becomes inoperative, the light gun is also used to direct radio equipped aircraft.

The frequency most generally used for airport traffic control work is 278 kilocycles. Receivers in the control tower will usually be tuned to 3105, 6210, and between 200 to 400 kilocycles (airways radio range and weather sequence broadcasts), and to airlines and military frequencies. As many as eight receivers will be found in the control tower of a medium sized airport. These sets will have been designed for control tower work, employ superheterodyne circuits, have a minimum sensitivity of at least $5 \mu\text{V/m}$ and employ either loudspeakers or headphones or both. In order that transmissions may be received from distant as well as local stations there is usually provided a means whereby the receiver is operating at full sensitivity and will not "blast" on local signals. Automatic volume control and manually operated sensitivity gain control circuits are usually incorporated in airport receivers. Where only one or two frequencies must be received, the receiver may be equipped with crystal control, thus assuring frequency stability. The band width of such receivers is never more than ten nor less than five kilocycles.

The transmitter may be remotely operated or be installed in the control tower proper, and have a minimum of 15 watts output into the antenna. The necessity for restricting the power of the airport traffic control transmitter is due in part to area limitations. That is, where airports are located relatively near each other, interference may result if high power is used. Too, there is no immediate necessity for using a transmitter having high power output because only a certain limited area must be covered and can be covered with a low power set. Some transmitters are designed so that an increase of power may be realized by merely flipping a switch; this increase

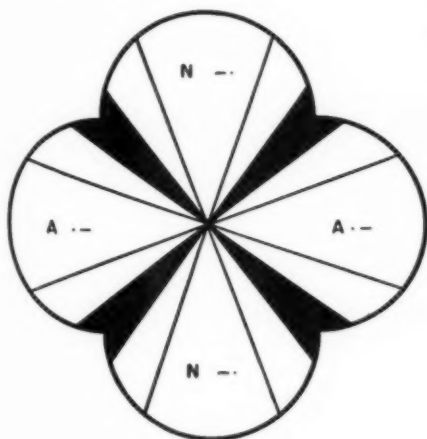
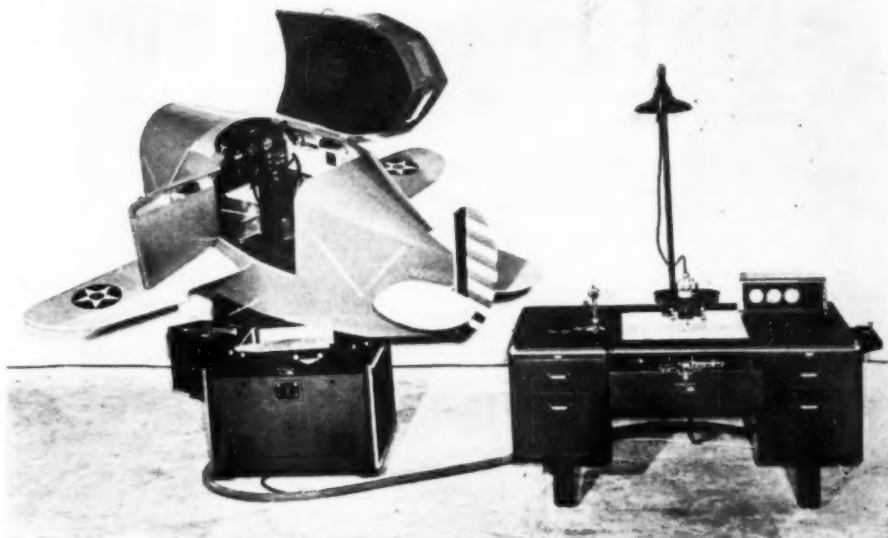


Fig. 1.



The famous Link Trainer has made it possible to instruct students in simulated flight procedure in the classroom.

in power only being used in cases of extreme emergency. Station interference, especially at crowded fields, creates confusion and much time is wasted attempting to contact departing and approaching aircraft. The modulation capabilities of the airport transmitter must be high in order to cope with signal to noise ratios at various locations. The speech equipment must be capable of delivering those frequencies essential to good intelligibility; and to this end most manufacturers have utilized the best equipment obtainable in their airport transmitters.

The new UHF equipment employed at the larger airports seems to be much more efficient than the "old" low frequency apparatus; and gradually will replace all existing low frequency equipment. This will necessitate changing all aircraft equipment either totally or in part. Some types of equipment designed for low frequency operation can be converted to UHF, but the expense involved would nearly purchase a new set specifically designed for UHF work. The latter is, of course, more desirable. In those sets costing less than \$60.00, circuit changes may not prove difficult and the conversion can be made for a small amount. However, no data is yet available which concerns the conversion of low frequency equipment.

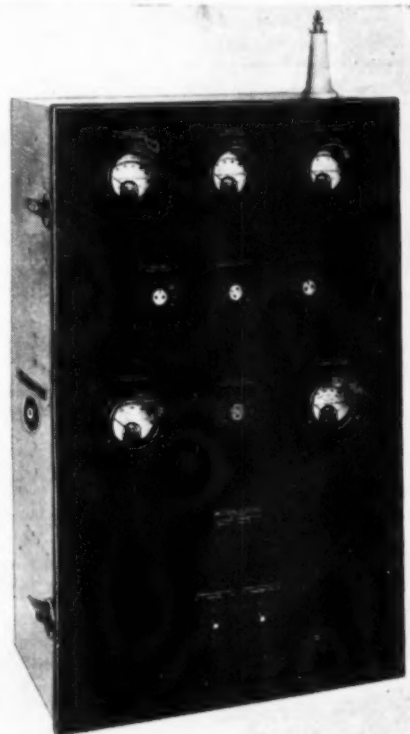
The advantages of UHF for airport traffic control are numerous. When it is considered that the signal to noise ratio of an UHF set as compared to the low frequency apparatus is extremely high; and considering the frequencies available, it is little wonder that an "all-out" adoption of UHF equipment is underway. If FM is used many stations separated only by control area boundaries can use one frequency; the power being the factor limiting coverage. There is no reason to believe, however, that FM will be used.

At those landing fields where train-

ing of student pilots is progressing, the air traffic problem is large. This is especially true at those fields where scheduled and non-scheduled or itinerant aircraft land and take-off in addition to student operated aircraft. The problem is a major one because it is necessary to dispatch the students at given intervals and at the same time take care of other aircraft. Usually, two or more control towers each having a transmitter and/or transmitters operating on different frequencies can readily take care of any air traffic situation. These control towers will be linked together with an interphone system which enables the operators to coordinate their activities in such a

(Continued on page 45)

Western Electric 10A aviation transmitter.



PRACTICAL RADIO COURSE

by ALFRED A. GHIRARDI

The subject of Reactance deals with Inductive and Capacitive circuits. Efficient tuning depends on these important topics.

Reactance of Inductances

THE e.m.f. applied to a direct-current circuit is opposed only by the ohmic resistance of the circuit.

As we have said in a previous lesson, the ohmic resistance depends upon the material, length, area, and temperature. In an alternating-current circuit containing inductance, the situation is somewhat different. The applied e.m.f. is opposed not only by the ohmic resistance, but also by the self-induced e.m.f. set up in the inductance by the rapidly varying magnetic field. The self-induced or counter e.m.f. is opposite in direction to the applied e.m.f. at every instant.

Therefore, in an a.c. circuit, self-induction acts just like resistance in the sense of "impeding" or opposing the flow of the current. This effect of self-

induction in impeding the flow of current is known as *inductive reactance*. It is equivalent to the opposition which a certain number of ohms of resistance would have on the current flow. Inductive reactance is represented by the symbol X_L , and is measured in *ohms*, exactly like resistance.

While we commonly express inductive reactance in *ohms*, just as we do ohmic resistance, the important distinctions between them should always be kept in mind. The *ohmic* resistance of a conductor depends only upon its material, length, area, and temperature. A given conductor has the same ohmic resistance whether it is straight or coiled up. In contrast to this, the *inductive reactance* of a conductor increases if the conductor is in coiled

form, and also increases if a path through highly permeable magnetic material is provided for its magnetic field.

The *ohmic* resistance is independent of the frequency (for all frequencies below that at which "skin effect" becomes appreciable), as illustrated at (a) of Fig. 1, whereas the inductive reactance *increases* directly as the frequency is increased (for then the magnetic field around the conductors varies a greater number of times per second, the wires are cut by it more frequently, and a greater counter e.m.f. is developed). This is illustrated at (b) of Fig. 1.

Because of this, circuits and coils containing a low ohmic resistance, but some inductance, may offer little opposition to the flow of current of low frequencies, but appreciable opposition (reactance) to the passage of currents at the high frequencies is encountered in the circuits of radio equipment. In fact, this property is often utilized in what are known as *low-pass filters*. Inductances are purposely connected into the circuit, and pass the low-frequency currents with little opposition, but greatly impede the flow of currents of high frequency.

The inductive reactance X_L , of a circuit, in ohms, may be calculated if the frequency f in cycles per second, and the inductance L in henries, are known. The formula is:

$$X_L = 2\pi fL = 6.28fL$$

The calculation of the inductive reactance of a radio component may be illustrated by the following example:

Example: What is the reactance of a 30-henry filter choke coil at a frequency of 60 cycles per sec., neglecting its ohmic resistance? At 120 cycles?

Solution: $X_L = 6.28fL = 6.28 \times 60 \times 30 = 11,308$ ohms at 60 cycles. At 120 cycles per sec., $X_L = 6.28 \times 120 \times 30 = 22,616$ ohms.

Note that the reactance or opposition which the inductance offers to the flow of current is twice as much at a frequency of 120 cycles as at 60 cycles. Note also how much an inductance of only 30 henries opposes the flow of current. At 60 cycles it opposes it just as much as would a pure resistor of 11,308 ohms; and at 120 cycles it opposes it as much as would a resistor of 22,616 ohms.

In our discussion thus far, we have neglected to consider the ohmic resistance of the inductive circuit. Actually, every circuit contains resistance; in fact, every inductance itself

uses wire in its construction and, therefore, has resistance. The total impeding force presented to the flow of current in a practical inductive circuit therefore consists of both the inductive reactance and the ohmic resistance. The *combined* effect of the reactance and the resistance is called the *impedance* of the circuit, designated by the symbol Z . Impedance, like reactance, is expressed in *ohms*.

The impedance in ohms of any inductive a.c. circuit is expressed by the formula

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{R^2 + (6.28fL)^2}$$

Suppose the ohmic resistance of the 30-henry filter choke, considered in the previous example, is 25 ohms. The total impedance which it presents to the flow of 60-cycle current will then be:

$$Z = \sqrt{25^2 + 11,308^2} = 11,310 \text{ ohms.}$$

Therefore, this 30-henry choke offers a total impedance of 11,310 ohms to the flow of 60-cycle alternating current, as compared to only 25 ohms resistance it offers to the flow of unvarying direct current. This illustrates the powerful current-opposing effect inductances may be made to have in a.c. circuits.

Reactance of Condensers

When a condenser is connected in an alternating-current circuit, as shown at (c) of Fig. 1, a periodic transfer of electrons takes place from one plate around through the circuit into the other plate and back again many times every second, depending upon the frequency of the alternating e.m.f. applied to the circuit. This constitutes a flow of alternating current in the circuit. The intensity of the current (amperes) depends upon the number of electrons which flow past any given point in a second. It is evident that

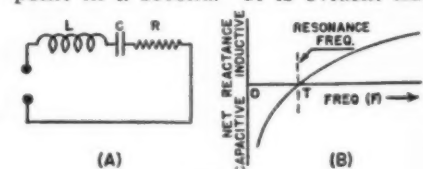


Fig. 1.

induction in impeding the flow of current is known as *inductive reactance*. It is equivalent to the opposition which a certain number of ohms of resistance would have on the current flow. Inductive reactance is represented by the symbol X_L , and is measured in *ohms*, exactly like resistance.

While we commonly express inductive reactance in *ohms*, just as we do ohmic resistance, the important distinctions between them should always be kept in mind. The *ohmic* resistance of a conductor depends only upon its material, length, area, and temperature. A given conductor has the same ohmic resistance whether it is straight or coiled up. In contrast to this, the *inductive reactance* of a conductor increases if the conductor is in coiled

Fig. 2.

this number is directly proportional to the frequency of the applied e.m.f. and also to the capacity (electrical size) of the condenser. In other words, the higher the frequency of a given applied e.m.f., or the greater the capacity of the condenser, the stronger is the current which flows, and therefore the less is the opposition which the condenser offers to the flow of current in the circuit. This opposition is called *capacitive reactance*.

reactance, and is expressed in ohms. It is represented by the symbol X_C .

In regard to frequency and capacity then, capacitive reactance varies or acts in a manner directly opposite to that of inductive reactance. Inductive reactance increases as the frequency or inductance is increased; capacitive reactance decreases as the frequency or capacity is increased. This should be remembered, as it forms the basis of the important principle of electrical resonance or tuning, which will be explained presently.

The capacitive reactance X_C of a circuit, in ohms, may be calculated if the frequency f , in cycles per second, and the capacity C , in farads, are known. The formula is:

$$X_C = \frac{1}{2\pi fc} = \frac{1}{6.28fc}$$

The calculation of the capacitive reactance of a radio condenser may be illustrated by the following example:

Example: What is the reactance offered by a 2 μ fd. condenser when connected in a circuit to which a 100 cycle e.m.f. is applied? What is the reactance if the frequency of the e.m.f. is 100,000 cycles?

Solution: At 100 cycles $X_C = \frac{1}{6.28fc}$

$$= \frac{1}{6.28 \times 100 \times 0.000002} = 796 \text{ ohms.}$$

(Note: 2 mfd. is equivalent to 0.000002 farads)

$$\text{At 100,000 cycles } X_C = \frac{1}{6.28 \times 100,000 \times 0.000002} = 0.796 \text{ ohms.}$$

It is evident from this example that a given condenser offers much less reactance or opposition to the flow of currents of high frequency than to currents of lower frequency. This is to be expected, of course, since at the high frequencies the condenser plates are being charged and discharged

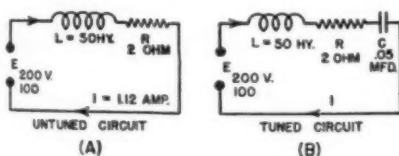


Fig. 3.

more frequently, resulting in a greater total flow of electrons around the circuit each second, and hence a greater number of amperes of current, which means the condenser has less reactance. This characteristic of condensers is utilized in electrical filters employed in radio and telephone work where condensers are used to by-pass currents of high frequencies (because of the low reactance they offer to these frequencies), and choke back currents of low frequencies (due to the much greater reactance they offer to these frequencies).

When a circuit contains inductance, capacity and resistance in series, as

illustrated at (a) of Fig. 2, the net reactance, X , of the inductance and condenser at any particular frequency is equal to the arithmetical difference between their individual reactances at this frequency (since they act oppositely in the circuit). Hence $X = X_L - X_C$. In any case, the smaller of the two reactances re-subtracted from the larger one and the net reactance, X , has the characteristics of the larger one, whose effect predominates in the circuit at that frequency. If the net reactances for such a combination were calculated and charted, we would

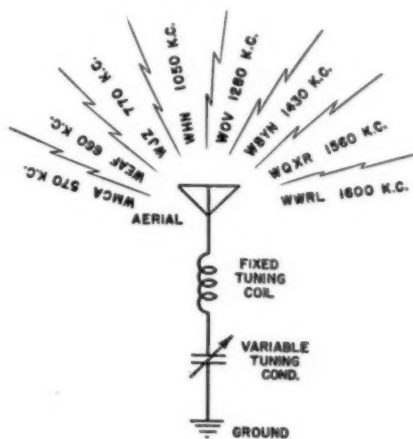


Fig. 4.

get the resultant graph shown at (b) of Fig. 2. At the lower frequencies, the capacitive reactance predominates. As the frequency is increased, the net reactance decreases toward the zero line in a regular curve, and passes through zero at some point T. At this point, the inductive and capacitive reactances are equal and opposite in effect so the net reactance is zero. As the frequency is further increased, the inductive reactance predominates, and the net reactance curve increases and continues upward.

At the particular frequency represented by the point T, since the inductive and capacitive reactances equal each other, the only opposition to the flow of current in the circuit is that presented by the ohmic resistance R alone, and the maximum amount of current will flow through the series circuit. This frequency is known as the resonance frequency of the particular coil and condenser combination, and the circuit is said to be in resonance or tuned at this frequency. At the resonance frequency then, the inductive reactance $6.28fL$ must equal the capacitive reactance $\frac{1}{6.28fC}$

Hence:

$$6.28fL = \frac{1}{6.28fC}$$

$$\text{or } f = \frac{1}{6.28\sqrt{LC}} \text{ (at resonance)}$$

From this fundamental relation, it is possible to calculate:

(a) the frequency at which reso-

nance will occur with a given inductance and capacity connected in series with each other;

(b) the inductance required to produce resonance with a particular capacity at a particular frequency;

(c) the capacity required to produce resonance with a particular inductance at a particular frequency.

In order to illustrate, in a practical manner, how the condition of resonance can be utilized to offset the current-impeding effects of either capacitive or inductive reactance in a series circuit, refer to (a) of Fig. 3. Here, a 100-cycle a.c. voltage of 200 volts is being applied to a circuit comprising an inductance L of 50 henries and a resistance R of 2 ohms. The total impedance Z which this circuit would offer to the flow of current at this frequency would be:

$$Z = \sqrt{R^2 + (6.28fL)^2} = \sqrt{2^2 + (6.28 \times 100 \times 50)^2} = 178 \text{ ohms.}$$

The current which would flow in the circuit would be:

$$I = \frac{E}{Z} = \frac{200}{178} = 1.12 \text{ amperes}$$

Now let us see how much current this same applied 100-cycle voltage of 200 volts will send through the circuit if a condenser C of the proper value to produce resonance at this frequency is connected in series with it. Since at resonance

$$6.28fL = \frac{1}{6.28fC} \quad C = \frac{1}{(6.28f)^2 L}$$

consequently, the value of C required to produce resonance in this circuit is:

$$C = \frac{1}{(6.28 \times 100)^2 \times 50}$$

0.0000005 farads, or 0.05 μ fd.

The current which would flow through the resonant circuit would be:

$$I = \frac{E}{R} = \frac{200}{2} = 100 \text{ amperes}$$

The tremendous importance of resonant circuits is demonstrated by this example. By introducing a condenser C of the proper value to produce resonance with the inductance L in the circuit at the existing frequency, the current flowing in the circuit was increased from 1.12 amperes to 100 amperes!

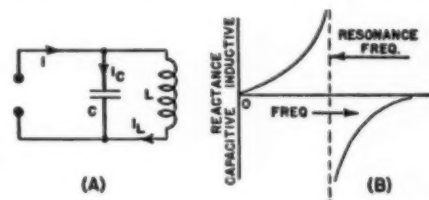


Fig. 5.

Resonant series circuits are employed extensively in radio receivers in order to receive with maximum strength the signals of only the desired radio stations by presenting a minimum amount of impedance to the

(Continued on page 60)

CENTRALIZED SOUND IN AN ORDNANCE PLANT

by **SIDNEY HARMAN** and **HASKEL A. BLAIR**

The David Bogen Company

Efficiency in military and civilian production and training plants has been stepped up as the result of new Sound Systems.

TWO of the most vital arms of the United States Army have always been Ordnance and Proving. The new and daily growing army has constantly expanded its facilities for testing new equipment and has embarked upon an extensive program of training ordnance men.

This article deals with a sound distribution system, specially designed by the *David Bogen Company* to satisfy the unusual requirements of a combined Proving Grounds and Ordnance Training Center.

A previous article dealt with a system employed by a Naval air station. The system was large—it covered considerable area and a large number of cadet barracks, but the areas covered might very well be lost, were they to be transplanted to the center to be discussed.

There are over 30 barrack blocks, most of them as long as a quarter mile, and each containing as many as 20 barracks, a separate mess hall, machine and testing buildings, and other facilities. The blocks have been so planned that the buildings enclose a drill area or parade ground and there is, in addition, a gigantic drill area approximately equal to 4 square barrack blocks in size.

The sound distribution system, it was originally decided, should cover every block, all connecting roads, the warehouse areas and the main drill area. For purposes of economy, it was decided to establish a system, the prime function of which would be to cover the ground areas involved, and not necessarily to distribute signals inside the various buildings. Signals were, however, to be of sufficiently high level to carry inside the various buildings. Thus, additional wiring and speakers inside the buildings were eliminated.

In order to obtain the required coverage, single poles were set up in the center of a number of the larger blocks, and clusters of four highly efficient reflex trumpets, each driven by 20 watts of audio power, were mounted to provide a 360° sound dispersion. The original survey indicated that in some cases two blocks could be covered by one cluster of trumpets

and that in one case, four blocks, so laid out that they formed one great rectangular area, could be perfectly covered by two poles located in such a manner that the cluster of 6 reflex trumpets, mounted on each, supported the other and served to cover two of the four blocks.

Central control panel is complete with tuner, monitor and switches.



In establishing the speaker layout, it was determined that one group of three blocks would require two poles supporting clusters of 4 trumpets each whereas another group of three blocks would need two poles, each supporting a cluster of 3 trumpets only.

The giant drill area is served by a cluster of six of the largest directional reflex trumpets manufactured, and this cluster has been mounted on a pole located in the center of the area.

It will be seen from the above that there were many differences in treatment throughout the center and these differences were the product of the unusual block layout, the variation in areas to be covered and the different noise levels and weather conditions anticipated.

The basic purpose of the system was to distribute air raid alarms and all clear signals. The extreme flexibility of Centralized Sound Systems has permitted the same system to be used for paging personnel, issuing orders of the day, distributing special radio programs and recorded music for parades and drills.

The following analysis of the system will be considerably clarified by reference to the functional schematic drawing.

When the surveys of the Proving Grounds and Training Center were first conducted, discussions were held with the purchasing authorities and Army engineers, concerning the functions desired and the various methods which might be employed to accomplish them.

There were three points of control, from which announcements, music, programs and alarm signals were to be issued. The main controls and the central rack were to be located in the Main Administration Building. At this point, it was decided, microphone, radio, phonograph, air raid alarm and all clear signals were to be issued.

Approximately 2 miles distant from the administration building, is located the Provost Marshal's office. From that point, it was desired to issue paging calls, orders, announcements, music for marching and specially recorded programs.

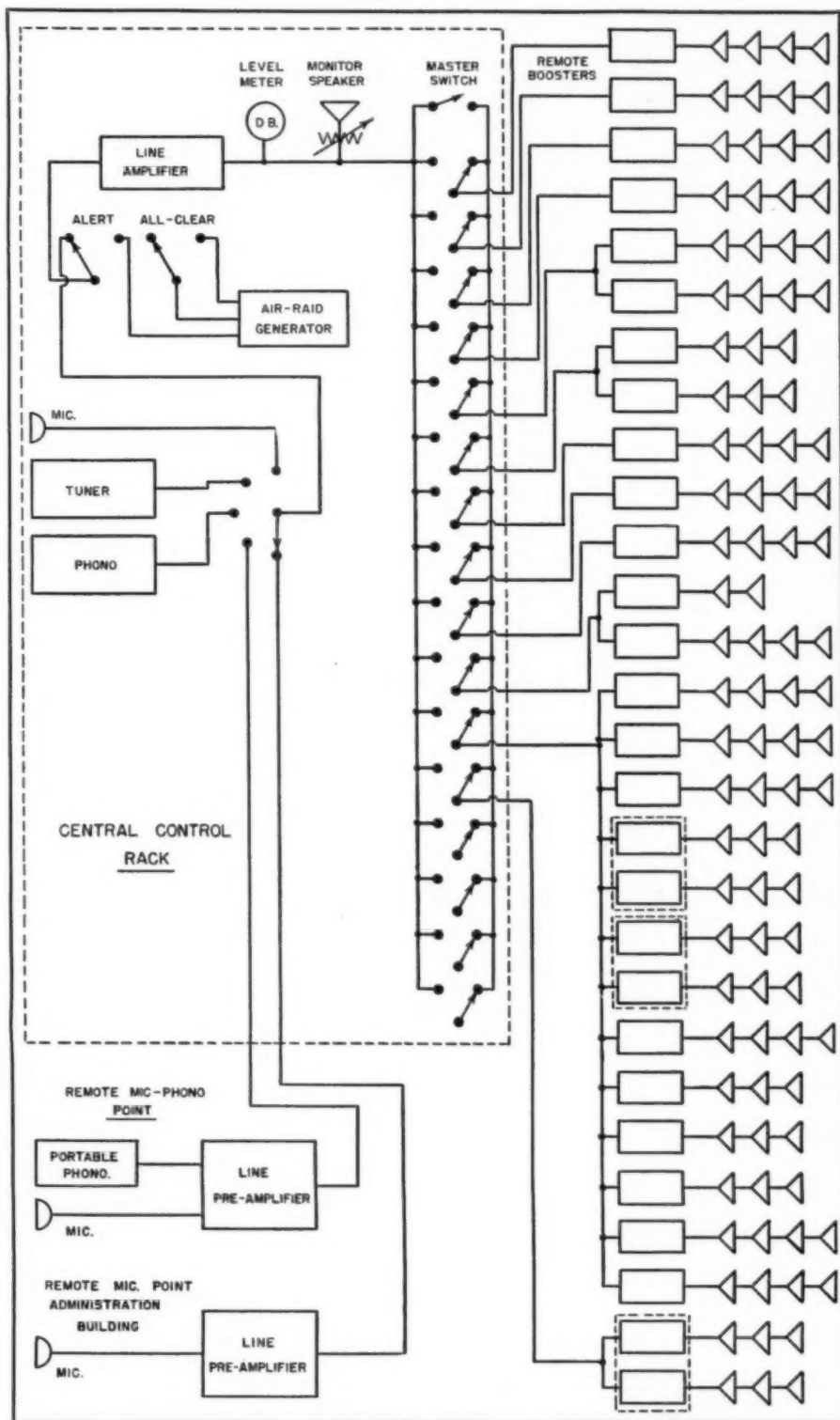
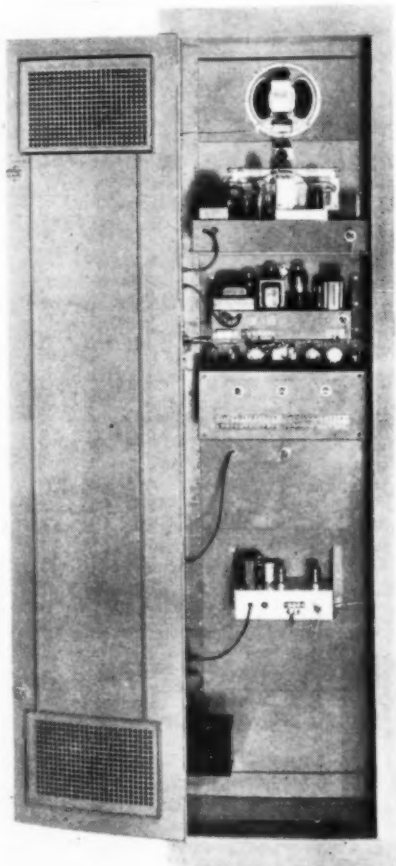
The Proving Grounds Administra-

tion Building located a mile from the Provost Marshal's office was to be equipped so that microphone announcements and orders could be issued through the main control rack to pre-selected areas.

It was realized after discussion between Bogen and Army engineers that the automatic precedence feature described in last month's article would be an extremely costly one. It will be remembered that this system operated in such manner that priority was established for certain calls and when such a call was issued, it automatically disconnected any other call which might have been in progress. This function was accomplished through use of relays, and it was recognized that the multiple wiring necessitated by such a system would be extremely costly when runs of two and three miles were involved.

An ideal solution to this particular problem was achieved by running low impedance zero level lines to both remote control points. At the Provost Marshal's station, this line was tied permanently into an outlet box, and a portable line amplifier (feeding out at zero level), a low impedance microphone and a portable phonograph were provided. This permitted the use of either the microphone or phonograph at points many hundred feet from the Provost Marshal's office. The line amplifier, as shown in the functional drawing, fed into the low impedance selector switch at the master control.

Equipment is easy to get at and is protected from room dust.



This extensive plan has been worked out to give maximum flexibility.

At the Proving Grounds Administration Building, another portable zero level line amplifier and low impedance microphone were used. This unit operated in precisely the same way as the one described above.

Before either of the two remote locations uses the system, a telephone call is made to the central control station, the time at which the remote will take control is established, and at that time the selector switch at the master is turned to the appropriate remote position and the necessary

speaker selective switches are depressed. Thus, "right of way" is given to the remote control station.

It will be seen from reference to the functional schematic that air raid and all clear signals have nonetheless been given precedence, for when the selector switch is thrown to air raid position, it automatically disconnects any other local or remote program.

The air raid alarm consists of a wobulated signal and the all clear of a sustained fixed signal.

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Manufacturer's Literature

Our readers are asked to write directly to the manufacturer for this literature. By mentioning RADIO NEWS and the issue and page, we are sure the reader will get fine service. Enclose the proper sum requested when it is indicated. This will prevent delay.

Dunco Issues New Guide

In addition to giving full details on hundreds of relays and timers for a wide variety of applications, the new *Dunco Relay-Timer Catalog*, just issued by *Struthers Dunn, Inc.*, Juniper and Cherry Sts., Philadelphia, Pa., has been designed to serve as a guide to relay and timer selection and usage.

Fully revised, greatly enlarged, profusely illustrated, and replete with detailed specifications and engineering information, the catalog is one that will prove helpful to designers, engineers, purchasing agents, production executives, and maintenance men alike.

In view of the extremely wide variety of *Dunco Relays and Timers* available for war or normal industrial requirements, particular pains have been taken to simplify their ordering. Standard units are listed in detail, following which complete information is given as to the many adaptations which may be obtained. This catalog introduces a new type designation system that greatly simplifies the specifying of required special features on units which are otherwise standard. Complete electrical information, as well as base dimensions, cover dimensions, coil data, magnetic structure diagrams and dimensions, contact diagrams, and descriptions, mounting styles, etc., are included. Several pages are devoted to a general discussion of the selection and application of *Dunco Relays* to meet practically any requirement. A copy will be sent upon request to *Struthers Dunn, Inc.* Ask for Catalog F.

Learning the Radiotelegraph Code

Designed to fill the need for a guide to the student of radiotelegraph code—a fast growing need now that many thousands of persons are interesting themselves in dot-dash communication as valuable training in the war effort—the publication of a special booklet entitled "Learning the Radiotelegraph Code" was announced today by the *American Radio Relay League*, national association of amateur radio operators.

The text presents a unique method of learning based on the aural system of approach. The radiotelegraph code is considered in the light of another language having its peculiar pronun-

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23 YEARS AGO in RADIO

{ CONDENSED FROM RADIO NEWS, 1919 ISSUES }

Transatlantic Radio Reception

WITH the opening of hostilities between the United States and the Central Powers, there arose the physical possibility that the enemy would interrupt the Transatlantic cables. In order to provide for such a contingency, it therefore became necessary to take steps to improve the then existing Transatlantic radio service.

Some time before the United States entered the war the *United States Government* through the *Navy Department*, in the interests of neutrality, assumed control of the Transatlantic radio transmitting station at Sayville, Long Island, and Tuckerton, N. J., these stations having been owned and controlled by German interests.

On October 4, 1917, a conference between representatives of the *Navy and War Departments* was held at New London, Conn., "relative to the substitution of radio for cable service in the Atlantic." At this conference a plan was formulated to initiate a system of Transatlantic radio communication "to serve in event of failure of cables between the United States and Europe as brought to attention by the *Interallied Protocol*, 22, August."

Design of Rogers "Ground" Antennae

NOW that the silence in regard to *Underground Wireless* has been broken, The Radio Amateur will undoubtedly be very glad to know a few of the facts in regard to its operation and installation.

One of the most favorable features of the ground antenna is its extreme sharpness of tuning. Even on the very long waves of from 10,000 to 15,000 meters, signals of but few meters difference from others of equal intensity can be easily copied without interference. This feature makes the subterranean system very adaptable to distant control installations. In fact, so adaptable is it that the control station need not be more than a few hundred feet from the transmitter.

Radio Translator

THE most promising device for the elimination of extraneous disturbances, including interference from other stations which we have investigated, is a device designed by this branch, a working model having been constructed in the *Signal Corps Field Laboratory*. Briefly, this device consists of a tuned reed associated with an electromagnetic system, and an external acoustic resonating chamber. The telephone receiver commonly employed with radio reception is incorrectly designed for use in radio work. The telephone receiver was originally constructed to reproduce the voice with its many overtones, hence the diaphragm is highly damped and has a comparatively flat resonance curve."

The static and other extraneous impulses excite the diaphragm, as well as the signals themselves. The signal impulses from a radio receiving set closely approximate a monotone; that is, the signal tone is comparatively free from overtones or upper partials. Quality or timbre therefore need not be considered in arranging to translate these electrical impulses into audible sounds. . . .

Answer of NC-4 by Radio Spread Over World in 3 Minutes

A RECORD in radio was established by the *Navy Department* on May 14, when a message was sent from Secretary Roosevelt to the NC-4 flying to Newfoundland, a reply received and relayed to Paris, London, Panama, San Diego and ships at sea, all within three minutes.

Naval officials said that no such speed had ever before been attained in wireless communications.

At 11:18 Acting Secretary of the Navy Roosevelt sent a message to the NC-4 as follows:

"What is your position? All keenly interested your progress.—ROOSEVELT."

Two minutes later the radio operator took the following reply from Commander Read of the NC-4 on the desk at the Navy Department:

"ROOSEVELT, Washington.—Thank you for good wishes. NC-4 is 20 miles southwest Seal Island, making 85 miles per hour.—READ."

Loose Coupling of Amateur Transmitter

NOW that the time for "sending" approaches I would like to register an appeal for loose coupling between the two oscillating circuits of the transmitting set. . . .

I will bet a good hat that I can take any good transmitting set and get better radiation on medium coupling than on maximum coupling. This is due no doubt to mutual inductance. That is to say the open oscillating circuit retransfers energy to the primary oscillating circuit that it would otherwise use up. But it must be remembered that the above condition will not take place unless the two oscillating circuits are in perfect resonance.

I have been in a government laboratory for a long period during the war and in my spare time I have carried out a number of experiments which have a bearing upon amateur work. . . .

Among other sets, I use a 1/2 kw. non-synchronous spark transmitter. A hinged oscillation transformer similar to the *Murdock* or *Blitzen* Radio-Coupler was used. I found that there was no excuse for using a closer coupling than 45'. In fact the antenna current increased up to this point. With the two circuits in perfect resonance I found it was possible to get a surprising amount of current flow in the secondary circuit with a coupling of 90'. The decrement with this arrangement proved to be .06 per complete cycle.

The advantages of sharp tuning are too evident to be repeated. The point I want to emphasize is that the transmitting set will actually cover a greater distance with moderately loose coupling than with close coupling. Any of the amateurs who had a pre-war range of 1,500 miles know this.

All of us will have to see that some plan be carried out to get sharp tuning after we open again. There will be a larger number of experimental stations than ever before. Think of the men who have received training in the army and navy who will go home with a lively interest in radio work. . . .

(To be continued)

TECHNICAL BOOK & BULLETIN REVIEW

"THE RADIO CODE MANUAL."

by Arthur R. Nilson. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y. Price \$2.00. 174 pages.

Every effort has been made to streamline text books intended for radio study. This new publication follows this procedure to the letter. Written by one of radio's Number One authors and instructors, "The Radio Code Manual" has been prepared with one principal thought in mind; i.e., to serve as an instruction reference to potential radio operators, and to take them through the various stages of learning in proper sequence, so that they may learn quickly and thoroughly, and to avoid the old fashioned round-about methods for learning the code. Included are twenty lessons on radio code and selected projects on code learning equipment.

Besides instructions in practice material on "sending and receiving," the book also has much helpful material on regulations with which the operator must be familiar, instruction of code practice, apparatus, and other information of vital importance. The contents of the book is spirally bound and each page lies flat in front of the student. We heartily recommend this book to all new students now engaged in the study of radio code or for preparation in obtaining commercial licenses.

"ULTRA - HIGH - FREQUENCY TECHNIQUES,"

by J. G. Brainerd, Glenn Koehler, Herbert J. Reich, and L. F. Woodruff. Published by D. Van Nostrand Co., Inc., 250 4th Ave., New York, N. Y. Price, \$4.50. 519 pages plus index.

The interest in the ultra-highs is increasing tremendously due primarily to the discovery that herein lies our most advanced form of communications, and furthermore that complete knowledge of the subject will indirectly make for a better world when our present turmoil is over. Our very safety relies today upon the use of the ultra-high frequencies in various types of military and civilian purposes. Many men have failed to qualify for exceptionally well paid jobs due to lack of knowledge of U.H.F. characteristics and applications.

The text covers a course which has been outlined by representatives of some 40 institutes, who met at Massachusetts Institute of Technology in November, 1941, to consider the demand engendered by the war for engineers and physicists with training in the ultra-high-frequency field. The book covers no specific military material. Its contents will be useful in time of peace as well as war and it represents

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by JERRY COLBY

ONE of the finest things about getting together with old time radio ops is the amount of beer one can guzzle, and the demonstration of the remarkable memories of those participating in a breeze shooting contest. Such were some of the highlights at the last VWOA, Hollywood meeting held in a spot where the temperature was high not only from the famous California sunshine, but also from the hot air floating around. Amongst those present were such well known glass wrist artists as Mac Schaeffer, Hal Styles, Mort Smith (shhh, he has a new assignment for Uncle Sammy) etc. and etc. Of course, the main topics were war and more war and quite a few of the boys in their own way are doing muchly towards making America safe from heels like Hitler and Hirohito. Ye ed still says that radiomen are the cream of the crop and if more Americans were radio minded, we believe that this war would have a very short life.

tainly hope that he can and wish him all the luck that a guy deserves who had the courage to invest a lifetime's savings in a probability.

LIEUT. (jg) ED PRICE, USNR, from Naval Reserve Lab., Anacostia, Washington, says he has been reading our column for the last nine years. Says he, "For several years I was a radio op in the Alaska SS Co. ships out of Seattle. However, my last berth was the venerable old West Camargo running from Seattle down to Rio and B.A. On a trip around to New York I got off and managed to crash the gates of television via NBC RCA and was there until the Naval Reserve called me in for duty. I wonder why more sea going ops with plenty of time on their hands for study don't get interested in the possibilities of television, radio facsimile, etc. From here it looks as tho there will be plenty of opportunities when this blitz is all over. Most of us who have come ashore from the Merchant Marine sort of figure on working that way permanently, but you never can tell when you might have to dig up the old telegraph ticket and start looking for a ship again. In reading your info about the new ROU I am wondering if they aren't going to make the same mistakes the ARTA did in its labyrinthic affiliations, "international" outlook, etc. It seems to me that one of the best ways the radio op can permanently improve his status aboard ships of the Merchant Marine would be to have legal status as officers. What has the ROU done on that score? We know, of course, what the comrades running the ACA did about such things: i.e., the Bill up before Merchant Marine Committee re legalizing radio operators as ship's officers. Their treatment of that bill was as neat a piece of sabotage (a word they should well understand) as I've ever heard about anywhere. The comrades covered their work up so well that none of us on the West Coast really knew what had

(Continued on page 63)



"Calling Car 13! Your left rear tire is flat!"



Spot Radio News



IN DEFENSE AND INDUSTRY

Presenting latest information on the Radio situation.

by **LEWIS WINNER**

RADIO NEWS WASHINGTON CORRESPONDENT

COPPER . . . THE METAL THAT'S TRULY worth more than its weight in gold today, has received a bit of reprieve from the WPB, for the military and civilian, too. The civilian relief covers the award of higher preference ratings to permit communications companies to obtain copper necessary for operating, construction, maintenance and repair. One of these orders is P-129 which raises the rating for telephone, telegraph, cable and radio companies from A-3 to A-1-j. This does not necessarily mean that copper will be immediately available to these companies, for the demand is still greater than the supply, but it does mean that it will be possible . . . more possible . . . to secure the copper more rapidly when either supplies are set aside for these requirements, or when production has increased to permit such supply. The latter has been true in some types of the metal in processed form, in some plants.

The military exemption list of the copper conservation order has been expanded to include containers for radio and communication equipment. Pending further discussion, some temporary exemptions have also been made. These include conduits for radio and communication equipment.

FACSIMILE TRANSMISSION AND RECEPTION, are now the recipients of a new set of standard definitions, prepared by the Institute of Radio Engineers. In this special supplement, definitions of terminal equipment, transmission and general items, have been presented. Terminal equipment definitions include those of density, length of scanning line, detail, recording, electrochemical recording, electrolytic recording, spot projection, transmission, receivers, spot speed, electrothermal recording, carbon-pressure recording, ink-vapor recording, frame, phasing, reproduction speed, etc. Transmission definitions cover such subjects as light, electrical negative, and positive modulation; converter; vestigial sideband; white-to-black amplitude range; white-to-black frequency swing; compression; expansion; distortion; signal level, etc. The general definitions include those of modulation, carrier wave, dual modulation, channeling, fading, echo, elongation, wave front, wave tail, power level, transfer ratio, nonlinear distortion, phase delay, envelope delay, cor-

rective network, impedance compensator, attenuation equalizer, noise, etc.

This interesting compilation can be purchased from the Institute . . . its cost being only 20c.

BROADCAST STATIONS ARE NOW ENGAGED in one of the most effective demonstrations of cooperation. Through the facilities of the National Association of Broadcasters, a bi-weekly bulletin is issued . . . called . . . Swap Bulletin . . . in which broadcast stations list material they want to sell, material they want to buy, as well as material they want to exchange. This listing affords stations an opportunity to locate much needed material and buy, sell or exchange not only at attractive price levels, but in many instances at practically cost-of-transportation prices.

The practice of swapping this way started some months ago, when the pooling plan was suggested. Aware that technicalities would prevent the pooling plan to be placed into immediate operation, the NAB conceived of the swap plan to temporarily alleviate the situation. The first few bulletins contained but a meagre listing. But the boys soon became acclimated to the plan, and today the listings include dozens of available objects . . . objects that few thought would be listed. For instance, in the latest release, appears a "for-sale" listing of



A corner of a communication factory, with but a few of the hundreds of thousands of spools of copper wire required for extensive radio transformer manufacture.

845 transmitting tubes, 838 tubes, 212E tubes, 852 tubes, etc. In addition, antennas, meters, frequency standards, crystals, motors, transformers are also included.

Reports from all quarters indicate that the plan is working so well, that the idea may be used in other communication centers, such as police, patrol, and defense units, where shortages are acute. Some dealers within local areas and even outside state boundaries have also been engaged in similar swap plans. This swap plan among dealers is a difficult one to practice, in view of the many personal problems involved. Notwithstanding, it has been applied and successfully, and thus warrants much praise. We hope that the many private differences can be ironed out among greater dealer areas so that real coverage can be gained . . . particularly in those centers where the demands for materiel are so great.

IN ONE OF THE MOST COMPREHENSIVE STATEMENTS issued since the beginning of the War, Lieutenant General Henry Arnold has analyzed our Aeronautical status most effectively, describing the various types of planes we are building, the types of planes we need, the types of planes we are combating, emphasizing, however, that it is manpower we need more than anything else.

We need radio operators, he said, as well as pilots, navigators and technicians. We need them urgently. Our training program, he explained, is the foundation of our aerial strength, and the keystone to the successes we must achieve and will achieve over the enemy wherever he is encountered.

The Army Air Forces, the Signal Corps and the Ordnance Department recently announced an intensive recruiting campaign to enlist 100,000 skilled mechanics and technicians. To keep pace with the materiel procurement program, the Army air forces needs radio mechanics and operators. The Signal Corps needs installer-repairmen and repeatermen, radio operators and repairmen, while the Ordnance department needs instrument repairmen, in addition to other types of technicians.

All applicants must be male citizens of the United States between the ages of 18 to 44 inclusive, and all must obtain clearance from their local Selec-

tive Service Board. They must be qualified for general military service, as determined by current physical standards. For service in the Signal Corps, applicants must have the same educational qualifications as for general enlistment. All men accepted will be enlisted as privates and sent to the nearest Reception center, from where those accepted for the Signal Corps will be sent to the nearest Signal Corps Replacement Center. While the men will be enlisted as privates, in view of their skills, it is expected that most of them will shortly receive non-commissioned officer or technician ratings, and rapid promotion may be expected. Pay scales range from \$50 a month for privates to \$138 a month for a master sergeant. In addition there are family allowances for men with dependents.

It is not essential that the men be radio experts before to finally become affiliated with the Signal Corps, for it is entirely possible that aptitude tests may show one without any previous radio experience to be suited to radio work. For instance, to select men to learn radio code, a radiotelegraph operator aptitude test is given. In many instances, men with no previous experience as radiotelegraph operators, but who indicate a high aptitude for this specialty, have outstripped more experienced men.

Women will also soon be affiliated with the Signal Corps, as a result of code classes recently formed by the American Women Volunteer Services. Directing the first of these classes in New York is Mrs. Mildred H. Marglin, the first woman radio operator appointed to the United States Signal Corps. Mrs. Marglin has the reputation of being one of the fastest operators in the Corps, having attained a speed of from 45-50 words per minute. She is a former amateur, having operated a station at Fort Knox. It was through her ham rag chewing on the air, that she met her husband, Staff Sergeant James Marglin, an instructor in communications in the Armored Force School. Mrs. Marglin receives the pay of a second lieutenant and is subject to full military discipline. She likes her job, she says, and feels that women will make good operators. Why not!

TO FACILITATE PRODUCTION INVOLVING CANADIAN companies, the War Production Board has placed the Canadian companies on the same classification basis as the American units, involving end-use of products. Thus the first five purchasers' symbols USA will now include the Canadian Army and Air Force as well as the United States Army. The USN will now include the Canadian Navy, Trafalgar Shipbuilding Co., Ltd., and Wartime Merchant Shipping, Ltd., as well as the USN units. Canadian companies will, of course, also use the same symbols as we do. Thus we continue the general policy of removing barriers to the

flow of strategic materials from this country to Canada.

TEMPORARY FREQUENCY SHIFTS of international short wave stations, when interference problems threaten the efficiency of broadcasts, will hereafter be possible, as a result of a new ruling issued by the FCC. The order provides the Chief Engineer, who is E. K. Jett, with authority to grant stations this privilege. Wherever feasible, the frequency authorized, shall, of course, be within the same megacycle band as the frequency specified in the regular license. The Board of War Communications recommended this step, as an "effort to insure the best and most continuous reception of United States international broadcast programs in foreign countries."

CONGRATULATIONS TO NEW YORK'S WEAf on its twentieth anniversary. On August 16, 1922, on the 24th floor of the American Telephone and Telegraph building, 24 Walker Street, New York City, WEAf first went into action. Helen Graves, then in the general manager's office, and now a computing room supervisor in the long lines department, was the featured soloist on this epic occasion. WEAf then had the high power of 500 watts ... a bit of a difference from the 50,000 watts it uses today.

The first day on the air covered three hours of broadcasting from 7:30 till 10:30 p.m. Their early schedule called for broadcasting from 4:30 to 4:30 p.m. weekdays and from 8 to 10 p.m. Monday, Wednesday, Thursday and Saturday.

Some of the firsts at WEAf were ... first simultaneous broadcasting by wire-connected radio stations between WEAf and WNAC, Boston (1923) ... first coast-to-coast broadcast hookup and demonstration of international and transcontinental wire telephony in Chicago: hookup including PWX, Havana; WCAP, Washington; WJAR, Providence; WMAQ, Chicago; KLX, Oakland and KPO, San Francisco (1924).

Among the veterans of WEAf are O. B. Hanson, who in 1923 was a long lines engineer and today is vice-president of NBC as well as chief engineer.



Where some of the "metals-for-war" are used ... a flare for aircraft use.

THEY'RE EVEN CURTAILING production of the common household meter ... or to be more specific ... domestic watt-hour meters, which include single phase, two and three wire types, with capacities up to 25 amperes and voltages up to 240, for use on a-c on any frequency. All existing meter manufacturing facilities will be converted to production of precision type combat instruments, gauges, measuring devices for the military services. This manufacturing curb will make available about 750,000 pounds of copper and 3,000,000 jewels, judging from the 2,000,000 meters of all types that were made last year.

Thus another in the line of meter manufacturing facilities falls in step with the military needs of the day. As in the instance of the other meters, however, manufacture and delivery of repair and maintenance parts will not be affected as long as inventories are limited to the average monthly stocks held by individual producers during 1941.

At the present, there will be no production or distribution limitations on polyphase meters or demand meters, and other similar types which are commonly used for industrial purposes.

Production on meters used for radio service instruments has been nil in many instances for quite awhile, in view of the shortage of jewels and copper. Some have been able to produce such units, using their stockpile, but this has been rapidly diminishing. Most of the meters made today are specifically for military or emergency essential use. It has even been difficult to maintain production of repair parts, because of the scarcity of various parts. However, industry and government agencies are bending every effort towards the production of maintenance parts for these instruments as well as radio in general. Thus far, no definite decisions have been made, but the outlook seems somewhat promising.

RADIO PRODUCTION QUARTERS are supplying some of liveliest slogans of the war. General Radio, for instance, has produced this one ... "U-most S-speed A-head." At Westinghouse, they say ... "He Who Naps Helps the Japs." At American Steel and Wire, it's ... "Let's ZINC the Hell Out of Them." Other topnotchers include ... "A Grenade in Time Kills Nine" from Eveready Company; "Minutes Saved Here Mean Lives Saved There" from Arma Corporation.

SECONDARY OR HIGH SCHOOL STUDENTS in New York State will now have radio communications classes. It will be taught in the twelfth year, with algebra, plane geometry and physics as the prerequisites. In some of the schools in New York State, the courses were given during this past summer.

This unusual teaching program has been widely proclaimed by Army and Navy officers, with official recommen-

dations from the Signal Corps school at Fort Monmouth and the Naval School at Noroton.

The course outline was originally developed in 1939 in cooperation with Ellis L. Manning, state supervisor of science and Francis E. Almstead (now Lt. (j.g.) Almstead of Noroton) and Kirk E. Davis. It was tried out successfully in the Wellington C. Mephram High School, Bellmore, Long Island, with pupils of average ability and above. Excellent records were made by the students in industry and military circles.

The plan of study was developed specifically to meet the need for basic training. The course is actually a laboratory course, and will be scheduled for not less than five periods a week, for a school year. Some of the topics covered are sound, the radio workshop, the code (this is optional), study of wave forms, vacuum tubes, a quantitative study of electrical circuits (includes a study of Ohm's law, alternating current phenomena, etc.), power supply circuits, rectifiers, coils and condensers, transformers, transmitter circuits, receivers, instruments.

The equipment to be used in these courses includes a variety of meters (voltmeter, milliammeter, ammeter, radio frequency meter), wheatstone bridge, resistance box, variable frequency audio oscillator, in addition to the usual necessary equipment required to build oscillators, receivers, transmitters, etc.

The text books to be used are standard editions such as used in most training schools, and include Radio by E. E. Burns, and Mathematics for Electricians and Radiomen by M. N. Cooke.

This training course is a noteworthy contribution to the present wartime program. In addition it offers the student a training that will have unusual advantages in peacetime.

THE TREMENDOUS PROPERTIES OF RADIO WERE brought to light in an unusual way in New York City, recently, when a recluse named Collyer emerged from his old boarded-up brownstone house to tell of a breathless tale of living in the dark for years. Although he had not seen a paper, and did not have any electricity or gas, he was nevertheless remarkably familiar with world events. For it seems he listened in every day to radio stations with a crystal set that he had built years ago. He also explained that he had a battery operated set. These batteries he managed to keep charged with some chemical process he developed, avoiding the use of electricity. However, he said, the crystal set was the best of the performers, providing constant performance. And we worry about tubes!

DID YOU KNOW THAT BECAUSE OF THE shortage of tin, there is now an acute shortage of solder in many centers? Every effort should be made to

conserve the supply. An excellent way to contribute to this conservation was explained at the recent meeting of the Toronto section of the Institute of Radio Engineers. The suggestion was that flux should be applied to old soldered joints when repairs are being made. There is usually enough solder on the old joint, and it takes only the flux to make it stick. Other conservation tips are . . . keep your iron in good condition . . . do not let it get overheated, so that the tin is burned off, requiring retinning and wasting solder. Watch you solder and your iron!

COMMUNICATIONS AND RADIO occupy featured spots in the curriculum of the United States Coast Guard Academy, located in Connecticut. In the four year course, during which cadets are trained in the same thorough manner as at the other service academies at West Point and Annapolis, communications in its various branches prompts intense study. A fine radio laboratory provides students with a close study of practical applications of materiel . . . applications that are of vast importance in these days of war. Today the coast guard has a tough job on its hands . . . but like all members of the services . . . it is coming through with rip-roaring success . . . with the boys from the Academy pitching in . . . in typical American iron-fisted determination . . . and radio doing its job on land and sea.

WANTED AT ONCE . . . says an advertisement of General Electric . . . wanted . . . worn-out transmitting tubes. For in view of the shortage of strategic materials used in transmitting tubes for civilian uses, and because the military needs are great, says the advertisement, General Electric is salvaging these metals from worn-out tubes of 250 watt plate dissipation or over. Because of the high cost of salvaging, and the added cost of shipping it is not possible to give credit on all tubes returned, explains the ad, but credit will be granted wherever possible. To ship, simply mark the cartons . . . defective apparatus for salvaging . . . and ship by express to General Electric at Schenec-



Here's a good idea of the size of some of thousands of power circuit coils used in transmitters.

tady. Here is a genuine opportunity to help!

MANY RADIO PLANTS are winning Army and Navy "E" pennants, as a reward for the production of radio equipment in an outstanding manner. The latest to win the award is Philco, who is not only making radio apparatus, but batteries and fuses for use in planes, tanks, guns and ships. The award was made by Brigadier General A. A. Farmer of the Signal Corps before 7000 employees and executives of Philco. James T. Buckley, president of Philco, accepted the "E" on behalf of the company.

THE HALLICRAFTERS COMPANY have been notified by Under Secretary of War Robert P. Patterson that they have been awarded the Army and Navy "E" Banner, according to an announcement by W. J. Halligan, President of Hallicrafters.

The Company was complimented in Mr. Patterson's notification letter for the "high achievement attained in the production of war equipment."

"The high and practical patriotism of the men and women of The Hallicrafters Company is inspiring. Their record will be difficult to surpass, yet the Army and Navy have confidence that it was made only to be broken."

Formal presentation of the "E" Banner was made Wednesday, September 9th at the Hallicrafters main plant by Army and Navy officials. Chicago civic leaders were present.

Congratulations Bill! from ye Ed.

Personals . . .

Robert Shannon, president of RCA, presented to **William Batt**, vice-chairman of WPB, a book containing the names of more than 20,000 employees of RCA, who have pledged themselves to "beat the promise" . . . **Ann Stankus** of RCA recently won the Award for Individual Production Merit with her suggestion of changing a plate in small radio tubes, thereby reducing the shrinkage to the extent that less skilled operators are now able to produce better tubes . . . **Arnold Nygren**, chief engineer of WFIL, has been commissioned a Lieutenant in the USNR, radio division of the Bureau of Aeronautics. **Louis Littlejohn** will act as acting chief engineer during Lieut. Nygren's absence. Mr. Littlejohn is vice-president of the American Communications Association and is also on the Domestic Broadcasting Committee of the War Communications Board . . . **Burton Browne**, Chicago advertising man, was awarded a Navy Proclamation of Gratitude for his Radar advertising campaign, which he originated and placed in more than twenty-five magazines. The presentation was made by **Commander Philip R. Weaver**, U.S.N. . . . **Louis Alexander** of Aerovox was recently elected a fellow of the Radio Club of America . . . There will be a 3 day meeting of the Society of Motion Picture Engineers beginning on October 27, in New York

City, according to present plans . . . Captain Leland P. Lovette now heads the public relations department of the Navy. Admiral A. J. Hepburn, former director, now heads the Navy's General Board. Captain Lovette served as director of the public relations department in 1937. In May 1940, Captain Lovette went on sea duty, and was commander of a destroyer division in the Pacific at the time of the Pearl Harbor attack. . . . Chief of the radio section in the Navy public relations branch is Harrison Hartley, who is a former special events man for NBC . . . Major General Olmstead recently was awarded the Poor Richard Citation of Merit at Philadelphia. Gen. Olmstead is the fifth recipient of the high award, presented by the Poor Richard Club, Philadelphia advertising organization.

SHORT WAVE BROADCASTING and transportation of recorded personal messages between troops in overseas stations and relatives or friends in the United States have been discontinued by virtue of an order issued by the War Department. The order pointed out that this method of communications was dangerous to the national security and in addition, unsatisfactory, in that there was no assurance that the messages reached the actual persons for whom they were intended.

This ban does not apply to short wave interviews or entertainments at overseas points, provided such has been approved by the War Department.

The recording of messages by troops for their friends and relatives had become one of the most popular pastimes at the encampments. It was an effective way of conveying that personal effect, that meant much to those listening in. However, there was great danger in such practice, since many of the messages, innocent as they may have been, may have contained information that was meant only for the ears of just one or two to whom it was actually directed and not groups who usually gathered around to listen in. In addition, many messages were revealing vital data, even though indirectly.

There is hope that the practice may be resumed, but in a more restricted way, provided, either a specialized "listening-in" unit can be assigned . . . a unit who would delete and perhaps authorize re-recording . . . or a regular program unit can be assigned to prepare scripts and direct the entire recording process. Both are intricate procedures, but they have possibilities.

The difficulty of securing adequate transportation for the bulky recordings, another cause for the ban, has a solution in the use of the exceedingly thin vinylite, having a .010" thickness.

THERE ARE ONLY FIVE F-M stations now operating on full commercial license authorization, according to the Federal Communications Commission, while there are twenty-three operating under special temporary authorization, pending completion in accordance with construction permits. Now, however, because war conditions have restricted equipment, material and personnel and thus made it difficult to complete installations to warrant a full commercial license, those with temporary permits will be granted a regular license for the duration, a license that will replace the special temporary authorizations.

There are twenty-one other stations, which hold construction permits, that will also benefit from this new ruling. These stations will have to show that construction has reached a point where the transmitter is capable of being operated to provide a substantial public service. There are also seven more stations that are now conducting program tests, who have filed applications for one of these new operating licenses. Under this new ruling, six stations now building studio-transmitter links, which provide "air" links from the studio to the transmitter, instead of via the co-axial line, will also benefit from this new ruling. Applicants for new facilities are, however, barred, except under special circumstances. This is in accordance with an earlier policy of freezing.

In this new ruling, the FCC showed that it was most interested in encouraging service for F-M listeners, and thus will give every consideration to the applicants with partial construction problems, provided such construction has proceeded to the point where

it is possible to provide a limited but satisfactory F-M service.

It thus appears as if this fall will see the inauguration of many F-M facilities in many cities that have not had much, in the way of F-M before. Some of these cities include: Lansing, Michigan; Salt Lake City, Utah; Amarillo, Texas; St. Louis, Missouri; South Bend, Indiana; Rockford, Illinois, etc. The cities of Los Angeles, Hollywood, Chicago, Boston, Detroit, Schenectady, New York City, Nashville, Pittsburgh, Rochester, Philadelphia, Milwaukee, Columbus, etc., will not only continue to be served, but now more completely than ever before.

GADGETS TO GUNS is the title of an illuminating leaflet released by the Office of Emergency Management, that reveals some facts that are truly startling. For instance, the booklet shows that shellac that would make six phonograph records, will waterproof the primer cups of 100,000 rounds of .30 calibre cartridges. The aluminum in two coffee pots, or several .001 mfd condensers, would provide enough of the material for two large incendiary bombs. Forty average phonographs require the plastics of the cowl of a pursuit ship. Solder and alloys in a medium tank require as much tin as 10,000 food cans would require. Steel of 12,000 razor blades or just a hand full of steel variable condensers equals the steel in the tail assembly of a 2,000 pound bomb. It is sometimes difficult to realize how these small civilian objects can be accumulated to provide the sizable objects of war so essential today!

RADIO CENTRAL, AN EMERGENCY SYSTEM OF CONTACT BETWEEN

broadcast stations, has been organized in New York City, with twenty stations in the link. This unique system provides the Army with a method of immediate contact with each of the twenty stations, by making a single phone call. The telephone network, organized for use during an air raid or other vital Army procedure, is manned on a full twenty-four hour basis by a four-man staff. Two of the day-men are supplied by the Army, while the stations supply the night force of two men.

The organization of this link assures all of the stations of instantaneously learning of any special Army news, and thus voids all possibilities of scoops and the resultant arguments. In addition, it assures the listening public of an immediate, accurate report of what the Government forces have to say.

The system has nothing to do with the Interceptor Command organization, which can order stations off the air, during an impending raid. The Interceptor system of monitoring other



"We'd like some aluminum discs.
It's all right—Joe sent us!"

stations in the area, which sign off upon hearing a signal broadcast by the key station to which they are tuned, will continue as usual.

The recent raid on Tokio was another important reason for the development of this Radio Central. It will be recalled that during that raid, the Japanese announcers provided the American raiders with a full running description while the raid was in progress, for not only had they been taken by surprise, but no pre-warning had been issued to the broadcasters. This, it is felt, will not happen with this new system in operation, should there be a raid. This system will provide a safeguard against the broadcasting of any information should such an emergency exist.

IT'S PRACTICALLY ALL OVER FOR SHELLAC for records, for the WPB has halted practically all civilian use of this materiel, except for certain specified uses. There is, of course, still available, the use of scrap, seedlac (a cheap grade of shellac), and the use of extenders which permits wider use of less shellac, without destroying the quality of the recording to any appreciable extent.

Up to now, phonograph record manufacturers have been able to obtain 30% of the amount they formerly used. The new ruling, which is an amendment to order M-106, does not set a specific amount of shellac for record makers, but does make them apply to WPB for any shipments. For this purpose, they have to use a form known as PD-617.

Shellac can be used in electrical equipment where it is required for maintaining the dielectric properties. It can also be used in communication instruments; as a cement for juncture of glass with the base stock in electric light or radio tubes; in navigational, aeronautical and scientific instruments, and other applications of a military or vital civilian nature.

Although laboratories have been at work seeking a suitable substitute for shellac for use on records, little success has been reported. The use of seedlac as a substitute does not assume too great a promise, for its ingredients are not too consistent. Thus, the surfaces cannot be tempered effectively. In addition, temperature effects prompt shipping difficulties, since records being made with seedlac react erratically in even normal climates.

FROM THE NATIONAL ACADEMY OF SCIENCES' advisory committee comes a recommendation to the WPB that the production of alumina, the raw material from which aluminum is made, can now be prepared from low grade domestic bauxite and from clay, by using new processes. This report comes after a year's study of possible new sources of alumina from clay, tailings, high-silica bauxite, alunite, kaolin clay, etc. These findings parallel the report made by yours truly in **RADIO NEWS** in March, 1942, which said . . . "new aluminum processing methods that have already been announced make it possible to extract alumina from abundant domestic clays. One such method, called the Hixson-Miller

process, uses high alumina high silica content clay, instead of bauxite."

It is hoped that the efforts to use the new processes will be pressed, for this will make it possible to conserve the supply of bauxite, which it must be said, does afford the best source for the manufacture of alumina and aluminum. Some of the new processes also call for the inclusion of a substantial quantity of clay with the bauxite feed.

EVEN CHOCOLATE MAKERS CAN help make communication equipment . . . strange as it seems. When recently one of the larger radio plants found it was in need of additional space, it made arrangements with a plant engaged in making chocolate candy, to supply its space and its girls . . . in the plant. For, for one thing, the girls who were adept at making the fancy chocolates, were found to be equally skilled with the use of their hands on the delicate radio equipment. In addition, chocolate plants must, of necessity, be exceptionally clean, with air conditioning apparatus to assist. This identical feature is imperative in plants engaged in making precision equipment. The only portion of the plant that wasn't used was the machinery, and this fortunately enough, was obtained by the radio manufacturer through the necessary WPB channels.

The conversion of this chocolate plant has served to solve an important problem for the chocolate industry, too, since the reduced cocoa supply has curtailed candy making and threatened to release thousands of candy makers. With the absorption of these skilled workers into radio, a major labor problem thus seems to be stemmed. It is expected that many more similar type plants will be converted to the making of precision parts for radio units.

A SEARCH OF A TRUNK hidden in the attic resulted in the finding of one of the most important collections of personal effects, recently; personal effects that belonged to none other than the Army's first Signal Officer, Brigadier General Albert J. Myer. The relics had been stored in the trunk, until a recent inquiry from the Office of the Chief Signal Officer prompted a search for them. Major Duncan Hodges, Signal Corps, on duty near Wiscasset, Maine, where the home of General Myer is located, made arrangements for acceptance of the articles.

Included in the exhibit is a red-and-white signal flag, similar in design to those which appear on the present Signal Corps insignia. According to the story told in the Myer family, this flag was the one which signalled the news of the surrender of General Lee's Army of Northern Virginia on the Battlefield near Appomattox in 1865.

Other articles found in the trunk included signal manuals, small signal flags, letter files, and many other per-

(Continued on page 49)



"What's your radio background?" Col. C. N. Sawyer, Signal Schools Commandant, asks a prospective trainee at the new Signal Corps Personnel Office in Chicago. Members of an inspection party, l. to r., Col. W. H. McCarty, Director Operations & Training; Col. E. Roth, Jr., Chief of Staff; Col. T. B. Catron, Control Officer; Maj. Gen. George Grunert, until recently Commanding General; Col. Sawyer and (r.) the prospective student.

RESISTORS for REPLACEMENTS



The Army, the Navy, the Air Force have first call on all the radio parts and equipment that can be made today. Their requirements are *vital*. Maximum dependability, stability and accuracy are essential under all of the severe conditions of war. That is why IRC resistors are specified, and why IRC is producing resistors 24 hours a day, 7 days a week.

This explains the increasing difficulties service men are experiencing in securing dependable resistors for repair and maintenance of home radio sets.

Realizing the importance of maintaining and servicing home radio sets, IRC is making available for servicemen large stocks of the same dependable resistors the armed forces are using (but in ranges and tolerances not called for on war orders) and are offering the following suggestions to enable servicemen to obtain greatest possible use of resistors in these times.

1/2-, 1-, and 2-watt Resistors

The resistors in home and automobile sets are almost invariably of the so-called "Preferred Number" or "RMA" standard resistance values and are color-coded accordingly.

Jobbers have, in the past, carried in stock the 1/2-, 1-, and 2-watt resistors only in "nominal" or round figure ranges such as 1,000, 5,000, 10,000 and 25,000 ohms, etc.

Now, however, many jobbers are stocking the IRC resistors in RMA ranges. These resistors are being furnished by the factory from stocks originally accumulated for the set makers before the manufacture of home sets was discontinued. They are of exactly the same quality previously used in the finest radio sets, but as they are not the ranges and tolerances required for military equipment, they can be supplied without interfering with the all-out war program.

A defective resistor in a set can always be replaced satisfactorily by a new resistor within

20% of the color-coded resistance value of the original unit.

In rare cases, where close tolerance units are used as original equipment, they are usually identified by a gold or bronze band for 5%, or a silver band for 10% tolerance. If a close-tolerance unit is required for replacement, two resistors, one higher and one lower than the required range, may be used in series or in parallel when matched for their combination resistance value.

If a 2-watt resistor is required and none is available from the jobber, two 1-watt units in series or in parallel will do the trick. Similarly two 1/2-watt units can be used instead of one 1-watt. Any low-wattage unit can, of course, be replaced satisfactorily by any higher-wattage unit of the same range.

Power Wire Wound Resistors

All wire wound resistors above the 2-watt size are becoming scarce because they are made of critical materials which must be conserved for war requirements. Fortunately, however, they are seldom required for service work except in A.C.-D.C. sets. Also, they are seldom used at their full rating.

If a wire wound resistor of the required wattage rating is not available, a combination of any types of lower-wattage units, either in series or parallel, may be substituted. In combining resistors for this purpose, the wattage rating is cumulative based on the number and rating of the resistors used.

Substitutions

It is daily becoming more necessary to make substitutions in many civilian industries to conserve the critical materials needed for winning the war. The substitutions suggested above will not affect the quality of replacement jobs. We hope that these suggestions may help to keep the home sets of the country operating.



INTERNATIONAL RESISTANCE COMPANY

401 NORTH BROAD STREET, PHILADELPHIA, PA.

R. F. GENERATORS

by WILLARD MOODY

A timely discussion on many types of oscillators for the experimenter, ham, and serviceman.

THERE are a great many forms of radio frequency generators. First, and most familiar of all is the vacuum tube variety which employs a triode or pentode in a feedback circuit. Then, and this form is used universally for stable operation, there is the crystal controlled osc.

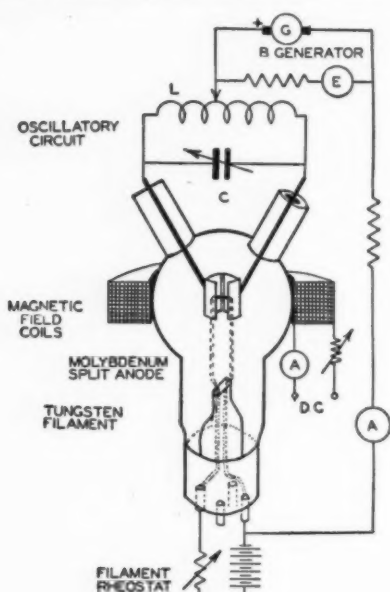


Fig. 1

In frequency measurement we come to the multi-vibrator and in the oscilloscope we have the saw tooth oscillator exemplified by the gaseous discharge tube, the thyatron or the neon tube in an R-C (resistance-capacity) circuit. Not to be forgotten is the original forerunner of them all, the spark coil of Heinrich Hertz. The Alexanderson alternator, the rotary converter, and the arc forms of radio generation of power are all basically sound and useful. One form of oscillator, since it produces radiation at a high frequency, is the X-Ray tube of Coolidge and Roentgen. The radio-active chemical called radium might also be classed as a generator since it radiates energy.

But the most important one of all, and the one in the writer's mind which offers the greatest possibility for development in radio and electrical engineering is the magnetron. This tube will produce appreciable power at the ultra-high frequencies, where the ordinary vacuum tube becomes weak and impotent.

Suppose that a beam antenna at

400,000,000 cycles were supplied high power, and that by means of directors and reflectors an enormous power gain were achieved in a single direction, that further this antenna was rotatable and could be directed against an invading airplane carrying its destructive bomb load. The power in the antenna and in that beam would be so great as to penetrate with ease the metal shielding of the plane and to burn up its ignition system, destroying it at once. With development and application of the magnetron this could be done. It now takes imagination to conceive such a possibility, but then who thought twenty years ago we would have our present development in radio and the sciences?

A sketch of the magnetron is shown in Fig. 1. A principal development of the General Electric Company, Schenectady, New York, its design and

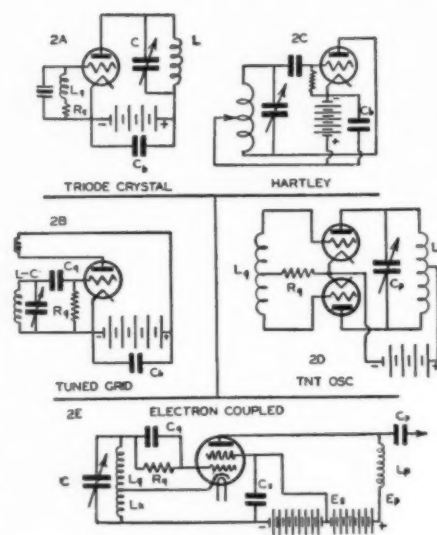


Fig. 2

circuit features have previously received attention in the literature.* Essentially, the tube is a two element affair, consisting of an anode or plate which is split to reduce eddy current or hysteresis losses and a cathode or filament. Alternating power may be used to supply the filament and d.c. can be used for the plate potential. With a 1500 volt generator or power supply the power that can be delivered or taken out of a tube of modest dimensions may reach 10 watts at 400 megacycles and 40 watts at or below 100 megacycles. A larger tube could be used, with water-cooled anodes,

for the transmission of more power. The flow of electrons may be controlled by electro-static deflection in the case of an ordinary triode tube or cathode ray tube and may also be controlled by variation in the magnetic field intensity surrounding the electron stream. A practical case of this kind is the magnetic yoke deflection of television tubes and the magnetic field variation of the magnetron tube. The magnetic field does not affect the frequency of oscillation which is controlled by the L/C circuit and the inductance and capacitance of the anode leads.

The magnetic field control may either be external to the tube or may be active on the tube filament current. The action of the circuit is one of "electron bombardment." The highly charged positive plate attracts the electrons from the cathode at terrific velocity. Traveling at a fast rate, these electrons hit the plate with a strong potential force due to their kinetic energy of attraction and "splash" electrons out of the plate. It's like throwing a heavy rock into a pool of water and getting a great spray. Each impinging electron may knock out from one to five additional electrons.

Examples of simple kenotrons, to which family the magnetron belongs, are the X-ray tube and the kenotron rectifier tube. Kenotron, from the Greek language, means literally "a thing with nothing in it."

It is interesting to note that around 1921 Alexanderson developed for RCA a synchronous detector for overseas c.w. reception. It was, simply, an application of the magnetron principle.

The highest frequency obtained to date has been with the magnetron form of oscillator and was of the order of 27,000 megacycles or about 1.1 cm. wavelength. The Barkhausen oscillator has generated power up to 5,000 megacycles or about 6 cm. wavelength.

Various oscillator forms are shown in Fig. 2 which operate on frequen-

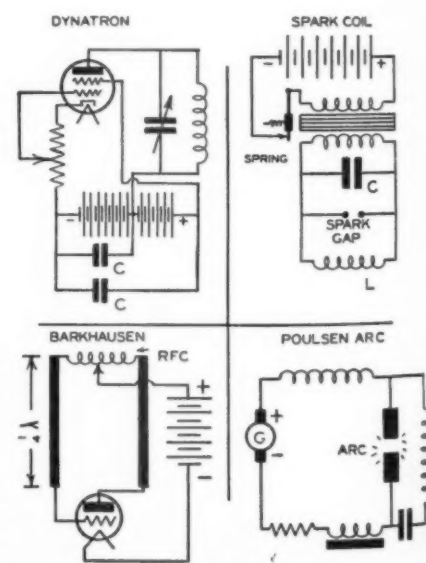


Fig. 3

cies normally used for communication. The Colpitts, the Ultra-Audion and a few others are not shown, these being merely modifications in one way or another of the basic oscillator circuits.

In Fig. 3 are shown forms of radio frequency generators which have certain unusual characteristics. The dynatron was formerly used for frequency measurement by heterodyne methods, until the advent of the now popular electron-coupled oscillator. It has a negative resistance characteristic of unusual nature.

The spark coil, of course, was one of the earliest forms of generation of radio frequency power. The Barkhausen oscillator operates in a transit time effect, with the grid going positive and the plate negative; electrons then go through the grid, are repelled by the plate, again come into the field of the grid. The cycle is repeated at a rate dependent upon the tube construction, spacing of electrodes and area of electrodes.

There are various other forms of generators, the magnetostriuctive oscillator which depends upon mechanical vibration of a rod in the field of the tank inductance, the Alexander-son alternator, the grid-glow tube or relaxation oscillator productive of saw-tooth wave form, the tuning fork, and the multi-vibrator, all of which are confined to low frequency operation close to the audio spectrum.

In thinking of oscillators, most radio men are inclined to forget the many forms of generation. The three element or multi-element tube has completely dominated the scene for the past decade. In high frequency, or rather ultra-high frequency, the magnetron will probably play a great role. It is, essentially, a two element tube. For a small tube with 1500

volt supply, the magnetic coil may have a diameter of about 24 inches and weigh 125 pounds, consisting of approximately 4,000 turns of wire.

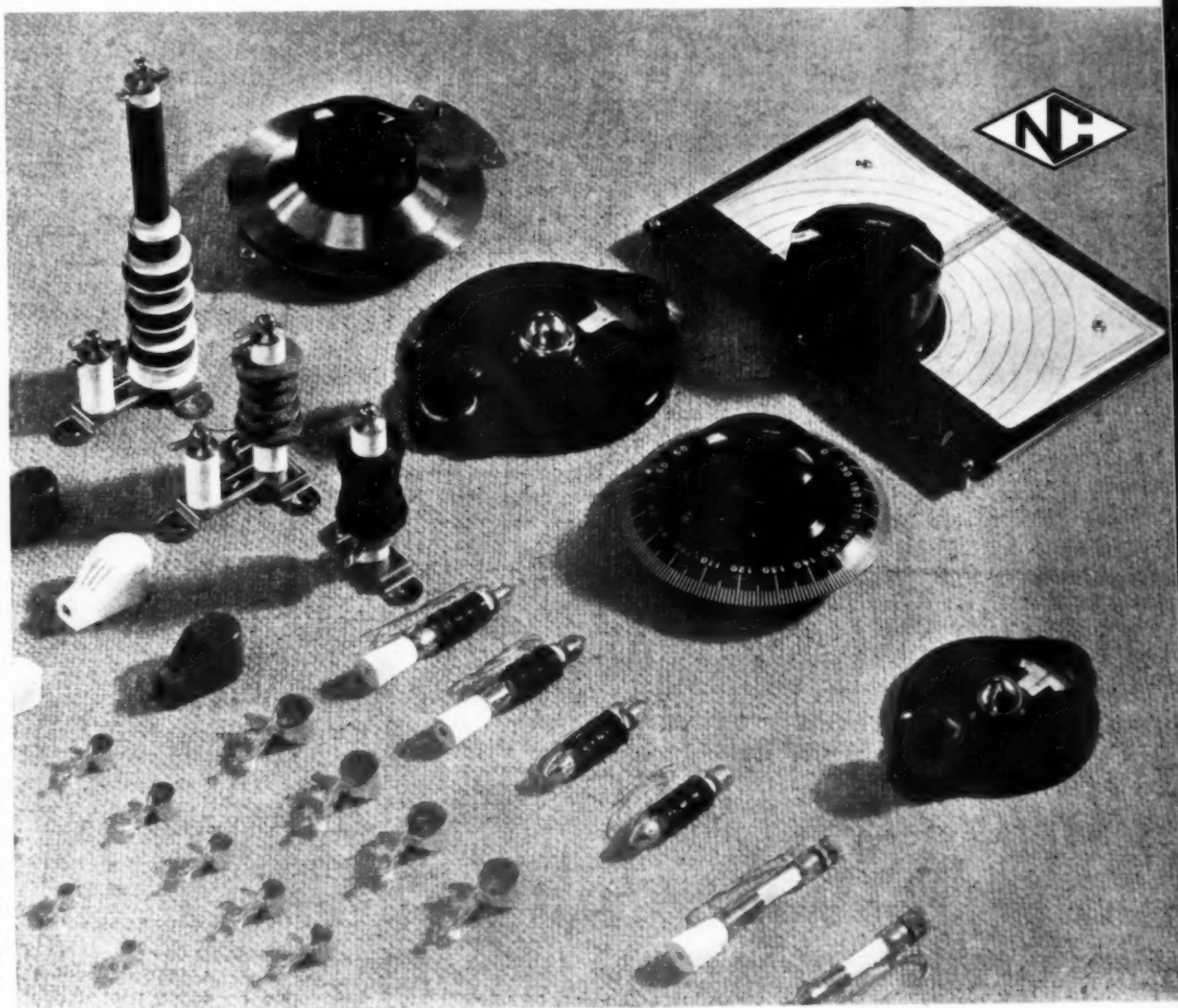
A great deal has been written about the many oscillators mentioned briefly here. Perhaps, as a result, some struggling young inventor, puttering around in his home workshop, will

stumble upon the answer to high power at ultra-high frequencies, after receiving an initial impulse and interest from this article.

Bibliography

* W. C. White, Electronics, April, 1930, page 34, Magnetron, a clear description and photographs.

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SURE, WE STILL MAKE PARTS!

You may have wondered. The fact is that all National parts are going into the War Program these days. On many items, National's facilities are taxed to the utmost in meeting the requirements of our customers. On other items, particularly those shown above, reasonable delivery can usually be made when the order carries a satisfactory priority rating.

NATIONAL COMPANY, INC.
MALDEN, MASS., U. S. A.

October, 1942

Navy Radio Ops

(Continued from page 9)

The officers' training school is another unique feature at Noroton . . . unique in that here again no radio background is necessary . . . and yet within 30 days . . . one month . . . the officers become sufficiently familiar with radio to become communications officers. These officers are almost entirely straight from civil life, and are college graduates, having completed accredited courses in anything and everything but radio. Nevertheless, they take a course . . . and it is a

course . . . for it begins at 7:45 in the morning and ends at nine in the evening . . . and takes in everything from code, both aural and video, to touch typing, theory and procedure. Their code course enables them to send and receive at about 8 words per minute, while theory and practical classes familiarize them sufficiently with all types of apparatus and their operation to stand them in good use when they go into service.

As soon as these young officers (the majority are ensigns, some are lieutenants [j.g.] and a sprinkling of lieutenants) complete their course, they are sent out to an active duty radio assignment, an assignment that can probably

be termed a portion of the course, for it is during this assignment that they receive much of the practical experience. According to reports, all of the communications officers that have graduated from this compact training course have done well and have proven themselves worthy graduates of Noroton.

The other division of training at Noroton, devoted to the Compool, is also an interesting example of effective training. Into this class comes a selected group of experienced radio and signal men who are taught flag and other visual signal methods and other activities fitting them for duty on merchantmen and the vessels that escort them in convoy. The course may be termed post-graduate and is given to those who come from other stations as well as Noroton. Here again, the course is a one-month affair, with long hours, plenty of studying and practicing and truly outstanding results as the merit of award. No college degree is required to enter this class, but you do have to know radio and visual signals and know it well.

Noroton is staffed by a group of truly seasoned radio veterans. Heading the staff is Lt. Commander Boyd Phelps, who is the executive officer and also head of the department of instruction. Commander Phelps is known to amateurs throughout the Nation and in many parts of the world, too, more familiarly as W9BP.

Another popular ham who is now at Noroton is Lt. Donald S. C. Comstock . . . W1MY. He is on the staff as communication officer.

Heading the materiel course of instruction is Lt. Perce B. Collison, who is known to amateurs all over. His call letters are W2IXE.

Lt. (j.g.) Francis Almstead, whose educational work, particularly on course outlines for use in secondary and higher schools is well known, is serving as an instructor at Noroton.

All members of the staff are members of the USNR. Captain Baggaley, the commanding officer of the school, is on the retired list of the Navy, recalled to active duty.

While Noroton is just reaching its second birthday, it has achieved an enviable record and position in training centers. The courses were not custom-made when the classes were about to begin. Instead they had to be created. And they were, with painstaking care and experiment. The result is evident from the record . . . a record of which the Navy says . . . Well Done.

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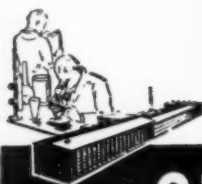


TODAY'S CONDENSER PROBLEMS WERE SOLVED YEARS AGO!

No matter how many condenser types war restrictions may make it impossible to supply . . . you're still in business as far as condenser replacements are concerned as long as you can continue to get Sprague Atom Midget Drys, Sprague EL prong-base Electrolytics, and Sprague TC Paper Tubulars.

Long ago, Atoms proved that they were the truly universal condensers—just the thing to replace any cardboard or can-type unit up to their rated values, and regardless of size. For higher voltages and wet condenser replacements, use EL's. For all tubular by-pass needs, use Sprague TC's—the most famous units of their kind in the history of Radio, and still the most dependable. These three types enable you to handle practically any condenser replacement job!

Practically all of Sprague's greatly enlarged facilities are devoted to war work, have been for a long time past, and will be until Victory is won. Although present jobber stocks of the above condenser types are largely complete, it is obvious that further production for civilian use must depend upon authorization from those in charge of the allotment of manufacturing facilities and critical materials.



SPRAGUE PRODUCTS COMPANY
North Adams, Mass.

**U. S. ARMY
SIGNAL CORPS
ISSUE
Next Month**

The Radio Sonde

(Continued from page 13)

1000 kc. oscillator is used for grid modulation of the 50 mc. oscillator. The audio frequency alternately indicates temperature and humidity and by changing audio frequency at definite intervals the atmospheric pressure is also indicated by a change in the audio signal.

The pressure diaphragm is evacuated and expands as the air pressure decreases with a rise in altitude, causing the lever to move over the switch mechanism consisting of metal-conducting disks separated by insulated disks. These disks are held together by a single bolt insulated from the metal disks. In the diagram a minor portion of the switch contact assembly is shown and an actual unit would have many more contacts.

A direct indication of air pressure is given by the position of the pointer. One out of five disks are made wider than the other four, permitting a switching into the grid circuit two fixed resistance values which give contact identification signals.

Contacts marked A make R the only frequency determining resistor in the circuit, and contacts B result in a frequency governed by the combination of R and RH. By variation of the number of B between each A contact a positive determination of pointer arm position can be made merely by observation of the audio signal and by counting the index signals.

Between each pair of index contacts are the narrower contacts connected to the movable arm of RH. The expansion and contraction of blonde human hairs as the humidity changes causes a variation in position of the movable arm. For any setting determined by the humidity, the frequency is chosen by R plus the resistance of the upper portion of RH and the frequency thus varies as the humidity.

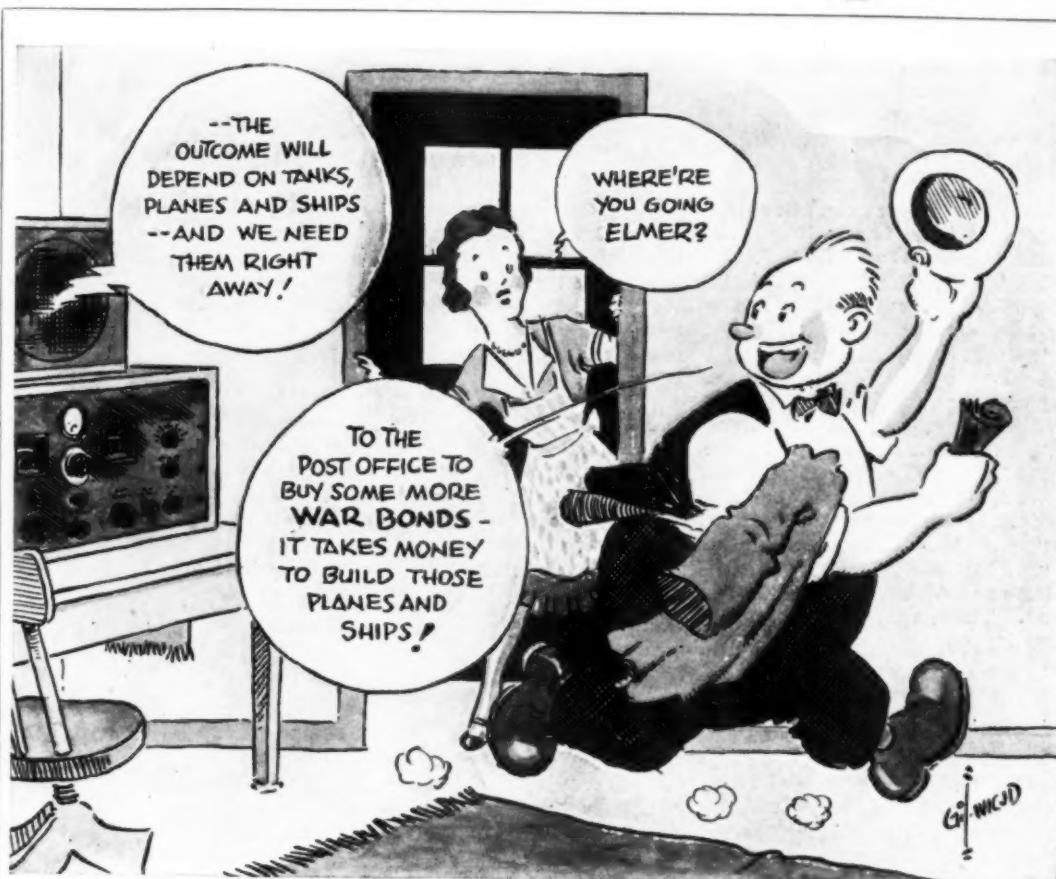
On an insulated disk between contacts, the audio signal frequency

is chosen or set by the value of RT, the sulphuric acid resistor that varies its resistance with temperature. Each time the pointer passes over an insulated disk, the resulting audio frequency provides a measure of the temperature.

Once the radio sonde is sent into the air, it may drift out to sea or otherwise become lost. But since the units if produced in quantity cost only about \$25, it is worthwhile to incur this loss

in order to gain valuable weather data that may save ships, warn farmers of storms, prevent airplane wrecks. However, some of the units are recovered. This is possible by incorporation of a parachute which lets the radio sonde float to earth, the parachute being released automatically when the balloon bursts in the stratosphere. Rewards are given to finders to provide an incentive for returning the equipment.

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Now it's WAR BONDS instead of radio equipment.

Buy Bonds as Elmer does with those extra dollars. Elmer is so enthusiastic because he knows the bonds he buys are going to preserve the principles which make possible amateur radio and all it stands for.



HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 WEST 34TH STREET, NEW YORK, N. Y.

For the Record

(Continued from page 4)

Twenty-Three Years Ago

WE begin a new feature this month which appears on page 32. Each month we will present, in condensed form, excerpts from previous issues of RADIO NEWS, which not only will bring back fond memories to you old-timers, but will serve additionally to acquaint you younger fellows with radio developments from out of the past. We feel confident that this section will become most popular.

Transmitting Tubes Wanted

MANY broadcasting transmitting plants, particularly those of low power, are in dire need of replacement tubes for their transmitters. Among these, we find the 800, 803, 806, 808, 813, 814, 815, 828, 866, 866-A, 866-A/-866, 872-A. Broadcasters are willing to purchase tubes which are either new or in good condition, and if you have any of the foregoing types, we suggest that you contact either your local stations or get in touch with the tube manufacturers. The need is urgent!

We Hams must not allow the broadcasters to be forced to shut down because of lack of replacements. We can help greatly by giving up those tubes for which we have no immediate need. There will be plenty after the duration.

Memories

RADIO men have long associated the Stevens Hotel in Chicago as the home of the Annual Radio Parts Show. The U. S. Army Air Forces took over this famous landmark officially on August 1. We had the privilege of witnessing the change-over from civilian to military and were conducted on a tour through the famous hostelry.

The huge exhibition hall where we were accustomed previously to spend many hours looking over the exhibits of the radio manufacturers was being made ready for partitioning and in the future was to be subdivided into many radio classrooms. The main dining room where epicurean delights have been served to "Chicago's Four Hundred" was now literally filled with mess tables. In place of the comfortable upholstered chairs were regulation army stools. Here thousands of students will dine in resplendent atmosphere, as the huge candelabra still remain. One thing is certain. Uncle Sam's draftees will be fed in keeping with the high standards followed in all of our military posts, and their vitamin contents will be comparable to the finest table d'hôte dinner.

We then inspected the elabo-

rate kitchens where "grub" will be prepared. Not a speck of dust was to be found. No longer do the K.P.'s have to whittle potatoes. Automatic machines do this very rapidly and thoroughly. The vast refrigerators revealed the morning meal—ham and eggs, and the beef for the following evening's mess.

We later saw the gigantic accumulation of all the silver service used at the hotel. Remember those champagne buckets? There were hundreds of them piled to the ceiling. Partitioned trays will replace these items.

The visit was concluded when we were taken to the parking lot to get our car. Instead of being approached by a civilian attendant with a request for our fee of 50c, we were stopped by an armed guard, as by this time the army had taken over this lot which is so familiar to many of you. We were among the last civilians to leave and drove out through lines of reconnaissance cars, trucks and jeeps. A strange contrast to the old days!

As we now go to press with this issue, the first contingents of students have arrived and are now engaged in their extensive radio training. Chicago is proud to be host to these thousands of young future radio men, and we look forward to the time when we will again greet them after the war is won, and we again are able to gather together every year for our Radio Parts Show.

First C. D. Radio Licenses

THE first licenses to be granted by the Federal Communications Commission under newly-established regulations for civilian defense radio systems have been issued by the Commission to the City of Akron, Ohio, and the City of Lawrence, Mass. Classified as War Emergency Radio Service, these stations extend the organized civilian units functioning under the

Office of Civilian Defense. In event of air raids or other enemy action which destroy other forms of communications, the emergency radio will be available to coordinate rescue and repair work.

Under the terms of the licenses granted, Akron will have a two-way low-powered radio system of sixteen receiver-transmitters.

Antique Tubes Wanted!

MANY thanks to you readers who have written in to offer to sell antique receiving tubes. We still need many more types in order to round out the rather extensive collection which has been accumulated and which is now on exhibit at one of the radio training centers.

The following types are still needed: 1903-1907, Fleming valves; 1908-1909, DeForest audion, DeForest audion with double plate; 1915, External grid experimental tubes, Lieben tubes, Telefunken (anode) flat-plate, Lorenz tube, Huth rec. tube, German types, Audiotrons in holders; 1916, Marconi-Osram plug-in triode, Tubular Audion (DeForest) Type T, Audion Detector (R59), Electron-Relay tube, Moorhead Detector, Tigerman Decto-amplifier; 1917, Pilotron Osc. Tube (GE), Thermionic repeater, Donle valve, Telefunken types (German); 1920, Moorhead relay & VT Amp.-Osc., A-P Electron-relay (Navy SE1444), VT 21, Lilliputian types; 1921, Edison Swan Elec. Co. ES2 and ES4, A-P Rectifier; 1922, Amrad S. Tube, Myers Audion RAC-3, First Sodium Detector (Donle), Welsh peanut WT501; 1923, French tube, N tube, Silvertone OT; 1924, Solodyne Nutron (English), Schotky (German), DeForest DV3, Schicklerling Triode; 1925, Magnavox 110v VT, Neon-filled rectifier, Luminotron photo cell (Nakken), Musselman Mogul 5VC; 1926, Quadrotion 4 element tube, 5VX; 1927, DeForest DL-4, Raytheon A rectifier, Sovereign top heater, Raytheon type R voltage regulator, CeCo M26, M27; 1928, Elkon metallic rectifier; 1931, Telefunken RES-664, Stenode Quartz crystal, Telefunken Bar-tube (Arcotron), Saxl micro-ray; 1932, Magnetron; 1933, Ag-AF-AE-Ad; Osram Catkin, Osram MH4, VMS, MS4B; 1934, McCullough Lilliput metal types, Marconi H-11 miniature; 1938, Electron multiplier.

If any of you old-timers have any of the above and would like to dispose of them, we would appreciate your letting us know at an early date.

BUSY days lie ahead. At this same time next month, we will have completed our work on the U.S. Army Signal Corps Issue. We know our efforts will not be in vain. In fact, we have never been so enthused before and after you have had the opportunity of reading that issue, we are sure you will agree.

73 OR.....



"I think I found the trouble lady—you forgot to plug it in!"

Aviation Radio

(Continued from page 27)

fashion so as to insure "uninterrupted" air traffic.

The airlines usually provide their own radio facilities, dispatchers, etc., but must coordinate their facilities with other services. Their weather is usually obtained from the U.S. Weather Bureau, but in some cases they provide their own weather reporting services. Flight plans of all aircraft are given traffic control centers at regular intervals so that a constant check can be made on airliners and in order that itinerant aircraft will not interfere with air transportation schedules.

Among the many aids to air navigation there looms one which has been given much consideration during the last eight years; it is the radio range or as it is commonly known, the airways radio beacon. High altitude flying has come into greater prominence since the advent of sub-stratosphere aircraft and because instruments are relied upon in cases of inclement weather when aircraft must fly without "ground check points" the radio range has figured conspicuously in the "all radio" air navigation plan.

With the exception of a few new UHF (experimental) stations which operate on frequencies between 117 and 127 megacycles, radio range stations today are all operated in the low-frequency spectrum, viz., 200 to 400 kilocycles. (Nearly all radio receivers designed for aircraft cover the beacon ranges in addition to the usual communication channels.)

The greatest percentage of stations now in operation are "simultaneous" stations. That is, voice broadcasts do not interfere with range

signals, and neither is interrupted as in old systems. Because the radio range signals are modulated at 1,020 cycles and essential voice frequencies transmitted at the same time a filter is needed in the receiver output which will attenuate the range signals and allow the voice signals to come through intelligibly. Most receivers during the last two years designed specifically for radio range reception

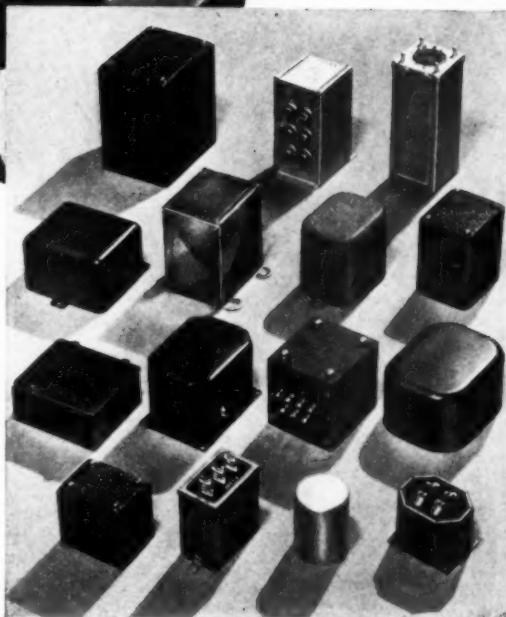
contain the necessary filter. External filters may be purchased for those receivers not so equipped.

The present day antenna system used with the simultaneous range transmitter for the radiation of necessary energy in pre-determined directions is essentially a modified Adcock system and consists of four self-supporting steel towers. The fifth tower which provides carrier and voice trans-



TOUGH?

Not when YOU'RE EQUIPPED TO HANDLE THEM



Illustrated are a few (just a very few) typical cases as supplied for some special applications

In addition to the electrical characteristics, many customers' application problems are related to the physical appearance and dimensions of their transformer components. Fortunately, the UTC sheet metal division supplies practically all the housings, laminations, brackets, and other devices which control the mechanical characteristics of UTC units. Instead of restricting designs to specific cases, the sheet metal division can run off a special case to more closely fit the final transformer dimensions, or to effect the particular mounting provisions required by the application.

The sheet metal division has drawing, forming, and other press facilities to cover the entire gamut of transformer housings from tiny transformer channels, to large oil tanks for broadcast and industrial service. Since these housings are produced at UTC, fast service can be given.

If YOU have a special problem, may we have an opportunity to cooperate?

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mission (simultaneous transmission) is located in the center of the four equally spaced towers.

In a few older range installations two loop antennae were utilized for beam course radiation. These two loops were mounted so that their planes were at right angles to each other. However, due to "night effect," etc., these have been undesirable. The theory of operation of the old system is quite simple, and can be applied to the new system to a certain degree because the patterns radiated from both systems are practically the same.

If a loop antenna were fed by a radio transmitter, it is known that the resultant pattern as transmitted by the loop will closely resemble a figure

"8." Now if we were to take two loop antennae and place them at right angles to each other (same manner as old system) we would find that we now have two figure "8" patterns. Too, we will find that there are four distinct places where the fields from the separate loops intersect each other. That is, the signals from one loop will be found to be super-imposed on the signals from the other loop. The resultant is then due to the difference in field intersection of the two individual loops and it is found that a different signal is obtained. In the modified Adcock system, a figure "8" pattern will be radiated if two antennae located diagonally across from each other are excited so that their currents

will be equal but 180° out of phase.

By controlling phase placement, current magnitude, power, etc., it is entirely possible to cause radiation of patterns along definite angles or courses; this is accomplished in the modern system. Course orientation is accomplished in the modern Adcock system by tuning the transmitter properly and feeding its signals into a link circuit relay which switches radio frequency energy into a variable coupling transformer which regulates the amount of energy supplied to our four antennae in pairs; by rotating the windings of the variable coupling transformer (goniometer) it is possible to shift the radio range beam courses. Of course, antenna site location, weather conditions, etc., have much to do with course alignment and cannot be disregarded.

Let us examine Figure 1 for a moment. We see our transmission pattern closely approximates two figure eights at right angles to each other. We have in reality, a four course range. The intersections of the lobes of both patterns is indicated by shading. In these shaded sections we find either the "N" or "A" predominating, but the on-course or "T" signal predominates due to the superimposition of the two signals, as indicated by the unbroken shading.

When the aircraft is in a position that is common to both loops; i.e., when signals from the two loops are received simultaneously and with equal intensity, it is said to be on-course and the letter "T" (a dash-) will be heard in the phones or indicated by lights. However, when the airplane is not in a position common to both loops, the signal "A" (--) or "N" (-.) will be heard or indicated.

The "equi-signal" or "T" zone is usually from eight to sixteen miles wide. That is, when the distance from the beacon transmitter is between one to two hundred miles. It can readily be seen then, that it is quite possible for an aircraft to fly the beam path of one station to the beam path of another and so on until it arrives at its destination. However, the actual orientation involved is no simple matter and requires a great deal of practice.

When passing from the right or East quadrant to the lower South quadrant of the range ("A" to "N"), the "A" will again predominate. It is to be remembered, however, that the on-course signal "T" will be faintly heard when in either the "A" or "N" zones and will become stronger as the aircraft approaches the on-course zone.

The pilot, in order to fly the range efficiently, must not only use the range itself for "positioning," but also his magnetic compass and other flight instruments deemed necessary in flying "under the hood."

In order that range stations may be identified, abbreviated call letters are transmitted about every 24 seconds. These signals are transmitted twice, viz., in the "N" and "A" quadrants. If the station is located at Los An-



"Sure, I'd Rather Drive 50"

...but until this war is won we all have to be satisfied with less in many things."

This is particularly true in the case of radio receivers, where the shortage of replacement parts is forcing more and more servicemen to improvise in order to get faulty sets into operation.

In so improvising it may be necessary to eliminate certain stages or find substitutes for certain resistors, condensers, or sockets, etc. While this may not produce the maximum in set performance, it will save a lot of jobs for you that would otherwise be lost. In addition, your customers will appreciate your licking a tough situation to get their sets into operation and, under the circumstances, be satisfied with less than perfection.

By this improvising, both you and your customer will be meeting your patriotic duty to free much needed replacement parts for use by the armed forces. At the same time, you will be contributing your share toward the building of public morale by keeping radio receivers in operation.

Of course, to improvise you have to know what's in the set. You can't spend hours "guessing out" the trouble and more hours experimenting with "probable" substitutions. You need RIDER MANUALS to tell you what is in the set—to supply you with all the facts you must have in order to find the trouble quickly and improvise the repair in the minimum of time. Speed is the essence today—reach for your RIDER MANUALS when you begin every job! It's your duty to work efficiently until "this thing" is over.

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**YOU NEED ALL THIRTEEN
RIDER MANUALS TO "CARRY ON"**

geles, the letters transmitted may be "LA" (.-... -.-), or if at New York "NY" (-.-... -.-).

Weather information usually transmitted at :20; :43; 48; and :53 minutes after the hour concerns the areas served by that station; and is usually a sequence of those stations within a certain allocated territory. In the event that special weather information is required any CAA station is able to supply that information if given enough time to request it from another station who has it. Weather data is supplied by the United States Weather Bureau who transmit these reports to various stations lying along certain air routes. Teletype is the media used for transmitting weather information, and in some instances point-to-point radio telegraph is utilized.

When an aircraft flying the radio range passes over "his" station "over stations" indication is usually given by a minimum or null signal in the earphones or minimum reading on a meter indicator (same type as used in the "LR" radio-compass). At stations equipped with marker beacon transmitting installation over station indication is usually indicated by a flashing light or meter indication if the aircraft is equipped with a marker receiver tuned to the correct frequency (75 megacycles).

The minimum or null signal obtained when passing over a station is sometimes called the "cone of silence." In the event that a receiver equipped with AVC is used for beam flying and the AVC circuit cannot be shorted out, true cone of silence indication will be hard to obtain as will quadrantal identification when passing from one zone to another. Because AVC maintains signal levels substantially constant the slight decrease or increase of signal cannot be achieved. This

is important because during periods when static and interference is bad, it is indeed a task to differentiate between increases and decreases in signal intensity. Therefore, when flying the beam it is mandatory that a receiver be employed which does not use AVC in its low frequency ranges. It is all right, however, to have a receiver equipped with AVC which can be used on the low frequency ranges when receiving voice broadcasts, and then with the

flick of a switch cut out the AVC when resuming beam flying.

There have been many systems for radio range flying promulgated during the last few years. Radio range navigation essentially consists of "spotting" the range, tuning in on its frequency, orienting the aircraft for proper on-course flight; and adjusting the receiver volume so that as minimum a signal consistent with good audibility is heard in the headphones.



U. S. NAVY OFFICIAL PHOTO

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Because each beam course is only so long it is relatively simple to figure out how long it should take to arrive over a cone of silence of one station after starting at the "outer edge" of another, if the pilot has properly oriented himself with respect to the correct quadrants.

Instrument flying, radio range navigation, etc., has been made rather easy of late by employing the Link Trainer. This trainer is equipped with sensitive altimeter, artificial horizon, air speed indicator, turn and bank indicator, rate of climb indicator, directional gyro, radio compass, an indicator which indicates over station location (cone of silence or Marker), and headphones.

Entering the trainer, the pilot closes the hood (may simulate take-off by calling control tower—who in this case

is the control table operator or instructor), unfolds his strip maps of the territory over which he will fly and advises the instructor that he is ready. The instructor will then let the pilot fly for a few minutes on-course and then will manipulate his controls affecting the radio range and lose him. The student then must find out where he is by definite flight procedure. During his flight he will hear his radio fade-out, the air will be bumpy, and all in all his flight in the trainer room will parallel an actual cross-country trip. Various problems are given to the student via telephone and as he solves each one is given another which "blends" in with the situation. Without leaving the ground, the pilot can "fly" from New York to Dallas entirely on instruments and radio, and if he is an apt flyer will usually arrive

at his destination. Because he knows that he hasn't a chance in "cracking up" the student proceeds with confidence in his Link Trainer flight and learns much more than he would if he were in an actual airplane in the air. Corrections can readily be made on the ground in the trainer room which are not always possible when in the air!

An automatic flight recorder (an instrument which draws the pilot's course as he flies it) is located on the instructor's desk and will give the pilot an idea of how he came out on his "problem."

New UHF range equipment will more than likely supersede the equipment now in use because of the freedom from static, fading, multiple-course phenomena, etc., but the principles of operation, etc., will no doubt remain the same. More stations may be required but their cost as compared to the low frequency installations will more than justify the outlay.

(To be continued)

Mrs. Lit.

(Continued from page 32)

ciation and syllables. Even though an individual cannot secure the constant supervision of an experienced radio code operator he may feel confident to go ahead and study by himself, under this new method. Fundamental sounds are learned first—then letter sounds are learned integrally instead of as separate dots and dashes; in fact, those terms are taboo and "dit" and "dah" have replaced them. The booklet includes much material on learning to send well, high speed operation, copying to typewriter, general operating data and code practice equipment, as well as a full set of lessons in learning to send and receive which are ideal for class instruction.

The League expects that extensive use will be made of the text in the numerous community evening radio training classes sponsored by its affiliated clubs throughout the country. It has already been approved by various official government agencies for such use.

The booklet is authored by John Huntoon, acting communications manager of ARRL, an amateur and commercial radio operator known for the excellence of his sending "fist" and who holds several championship trophies for his first-place performance in receiving competitions.

-30-

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Radio Coat

(Continued from page 20)

as a contact for controlling the transmitting circuit as differentiated from the receiving position of the circuit, when the switch is in its normal position. Conventional plug or terminal insulating blocks may be provided on the battery and on the radio unit proper for accommodating the sockets of the detachable plug, and socket connectors, at the several points where electrical connections are made with different parts of the system. These plug or terminal insulating blocks may be employed at the earphones or receivers, as well as at the microphone, or at other points, in addition to the battery and transmitting and receiving equipment.

When this "two-way radio garment" is in operation, signals may be received by leaving the switch in a normal position when the earphones are worn, as illustrated in Figure 3. When transmitting signals or voice instructions, one hand is put through the pocket opening to change the switch to a sending position, and the microphone is placed to the mouth so that a two-way conversation may be conducted—or orders given, as in case of a commanding officer on the battlefield. The change from transmitting to receiving positions is accomplished in a jiffy.

The whole equipment is relatively small, compact, and light in weight. To say that it is portable would be like carrying coals to Newcastle—because the wearer carries all of it on his back. The garment may be used as an overcoat in winter and outer coat in summer. Waterproof, fireproof heatproof, it may be worn in many climates and countries—in the Libyan desert, or the frozen steppes of Siberia, and in the temperate zone of our own hemisphere.

The smallest broadcast receiver having four tubes and about the size of an inch-section of a glass medicine dropper; a crystal set mounted in a coconut shell; a portable receiver of the size and semblance of a kodak; a walking cane capable of transmitting and receiving signals within the shadow of a broadcasting station; suitcases containing complete and adequate receiving sets; vest-pocket edition of receivers smuggled in one's clothing for bootleg purposes at race tracks; and compact sets on automobiles, boats, bicycles, and every conceivable vehicular conveyance—these are some of the manifestations of radio in compressed forms, so those that travel may tune and listen. But a wise Solomon, speaking of a person arrayed in fine cloth, or a Jules Verne, in his greatest flights of imagination, never conceived of man wearing a coat literally made of radio.

Editor's note: For obvious reasons, no diagram of the radio circuit is shown and is not available —50—

Spot News

(Continued from page 38)

sonal effects.

The relics were placed on permanent exhibition in a special section of the Signal Corps library in the Pentagon Building, Arlington. The exhibit was formally opened by Major General Dawson Olmstead, the seventeenth and present Chief Signal Officer of the Army.

TO PROMOTE THE WAR PRODUCTION DRIVE, the WPB has issued a handbook of helpful services for joint labor-management committees, in which a

complete description and explanation of how to obtain materials to carry on the drive, appears. Featured in the information is a discussion of the speakers, films, exhibits available for plants. The official U.S. War films offered describe many unusual facts that should prove vitally interesting to all Victory workers. Described, too, are available transcriptions for broadcast stations, and the silent salesmen of the war . . . posters . . . stickers . . . bulletin boards . . . as well as material for plant newspapers or house organs. It's perfect ammunition for the drive . . . the drive for more . . . more production . . . that Americans will deliver! —50—

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Compact Z-Meter

(Continued from page 12)

only necessary to line up the 20-ohm graduation with the bar-knob pointer when the rheostat is at its normal cut-off.

If it is desired to make a special volts scale for the milliammeter, the meter should be removed from its case and the milliamperes scale carefully lifted out. A piece of reasonably thin white paper may be pasted smoothly over the milliammeter scale, or an entirely new face may be cut from thin white Bristol board after tracing on the latter the outline and mounting holes of the original face. The builder may use the values given in Figure 4 if he has no need of great accuracy, translating the voltage values directly to the new scale with a pair of dividers set to corresponding values on the original milliamperes scale.

If, on the other hand, a direct-reading volts scale of individual calibration is desired, the blank face of Bristol board is screwed to the meter which is reconnected into the circuit. The case is not replaced on the meter. The Z-meter connections are then shifted by switching, as described earlier in the article, to make the v. t. voltmeter externally available. A source of variable a.c. voltage is provided. This may be a 6.3-volt filament transformer with its low-voltage secondary connected to the extremities of a 10,000-ohm wirewound potentiometer. The potentiometer output is then fed into the v. t. v. m. input terminals of the Z-meter and an accurately-calibrated a.c. voltmeter connected to show the value of input voltage.

The instrument should be allowed to heat for at least 30 minutes. The v. t. voltmeter is then balanced to zero and the calibration may begin. The a.c. input voltage is adjusted to 0.2

volt and the position of the meter pointer along the new scale marked with a single dot. The input voltage is then advanced to 0.4 volt, 0.6 volt, 0.8 volt, 1 volt, etc., the exact position of the pointer being marked at each new voltage. The meter shown in the photograph reads 1, 2, 3, and 4 volts with intermediate graduations every 0.2 volt between these figures. A tenth of a volt is easily readable on any part of the scale.

After the voltage points have been carefully marked, the special scale is removed from the meter, inked in permanently, and replaced. The meter is returned to its case and fastened permanently into the instrument.

How to Use the Z-Meter

In all applications, the instrument is connected to the line, switched on, and allowed to come up to operating temperature. This will generally require about ten minutes, although a longer warm-up period should be permitted whenever the time may be spared. The vacuum-tube voltmeter is then set to zero by manipulation of the rheostat, R7. There must be no external connections to any of the input jacks (X1, X2, TV, or TV₂) during these preliminaries. After warming up sufficiently, the instrument is ready for service.

Impedance Measurements. (1) Connect the "unknown" coil to input jacks X1 and X2. There is no particular polarity to observe. (2) If impedance measurements are to be made at 60 cycles, remove any plug which may be inserted in the jack, J. (3) Throw switch S2 to connect the internal measuring resistor (this is the right-hand position in Figure 3). (4) Throw switch S1 to connect the v. t. voltmeter across the coil (this is the "up" position in Figure 3), and note the resulting reading of the meter. (5) Throw S1 in the opposite direction so that the v. t. v. m. is now connected across the measuring resistor (this is the "down" position in Figure 3) and note that the voltage reading differs from the one previously obtained. If this second voltage indication is lower than the first, the setting of R2 must be increased. If it is higher, R2 must be decreased. (6) Continue adjusting R2 until the meter reading does not change at all as S1 is flipped back and forth. When there is thus no longer a voltage change, the unknown impedance may be read directly in ohms from the scale of R2. A convenient fact is that the meter reading at "balance" is always the same regardless of the size of impedance measured. For an a.c. test voltage of 6.3, for example (such as is obtained in the circuit of Figure 3), this voltage is always 3.15.

Reactance Measurements. The capacitor of unknown reactance is connected to the input terminals, X1-X2, and the same procedure followed as outlined under *Impedance Measurements*.

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Measurements at Other Frequencies. When it is desired to make impedance or reactance measurements at frequencies other than 60 cycles, the internal 60-cycle source may be interrupted automatically as the new-frequency voltage is injected. This is accomplished by the two-circuit jack, J. When voltage at the new frequency (for example, 400 or 1000 cycles) is introduced into jack, J, by means of a standard phone plug connected to an audio oscillator, the plug itself opens the 60-cycle contacts of the jack, permitting measurements only at the new frequency.

After thus connecting to an external oscillator, measurements are made according to the same procedure outlined under *Impedance Measurements* and *Reactance Measurements*.

Use of External Measuring Resistor. Occasionally the operator may desire to make impedance or reactance measurements outside of the resistance range of the self-contained rheostat, R2, or with greater precision than is possible with the rheostat. In this case, (1) connect an external calibrated resistor or laboratory decade box to jacks TV₁ and TV₂. (2) Throw switch S2 to connect the external resistor and disconnect the internal one (this is the left-hand switch position in Figure 3). (3) Make measurements as outlined under *Impedance Measurements* and *Reactance Measurements*, but by adjusting the external resistor instead of R2, and reading the impedance of reactance values from the external resistor rather than the scale of the Z-meter.

Inductance Determinations. Coils may be checked for inductance with the Z-meter provided the d.c. resistance of such coils is small compared to the reactance. Then, assuming that the Z-meter indication is largely one of inductive reactance, the inductance may be found by dividing the Z-meter reading by 376.8 when the test frequency is 60 cycles, 2512 for 400 cycles, or 6280 for 1000 cycles. For convenience, inductance values for 60 or 1000 cycles may be placed on the Z-meter scale along with ohms.

Special Precautions When Measuring Transformers. When measuring the impedance of transformer windings, it is essential that the unused winding be connected to a resistance corresponding to the resistance or impedance into which or out of which it generally operates.

-30-

Centralized Sound

(Continued from page 31)

The further question of standby operation of the twenty-eight remote booster amplifiers was considered. The usual method of controlling either the plate supply or both the plate and filament supply by relay operation when the master talk key was depressed,



The bomber must be built and the crew must be trained.

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RADIO NEWS *for November*

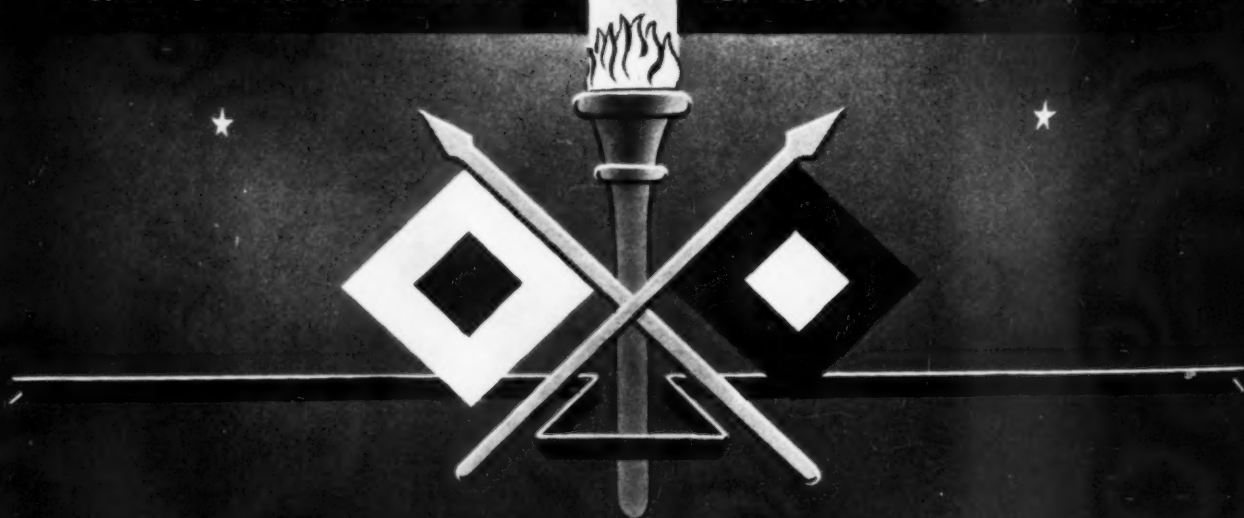
The Complete Story of the U.S. Signal Corps

by The Signal Corps

. . . authoritatively presented by Officers
of that branch of the U. S. Army, dramatically portrays
the vital role Communications plays in the War. . . .

The special November U. S. Signal Corps issue of RADIO NEWS presents a complete, authoritative account of the vital communications branch of the Service. Written entirely by Signal Corps officers, each of whom is an expert in his branch of the Service, this special issue of RADIO NEWS includes brilliantly illustrated articles on: The Signal Corps in War, The New Signal Corps, History, Development of Field Sets, Signal Corps Research, Laboratories, Meteorology, Training, Army Signal Service, Signal Corps in Aviation, Supplies, Signal Corps Equipment in Mechan-

ized Units, Portable Ground Signal Equipment, Communications by Wire, Army Amateur Radio Systems, Photography and many other functions of the Service. A special section has been given over to the Signal Corps Radio Course, made available in this form for the first time — valuable instruction for future Signal Corps men as well as reference guide to all members of the Signal Corps. Also featured are two special pictorial sections in natural color and in black-and-white gravure of fine salon quality — striking photographs of the Signal Corps in action.



SPECIAL U. S. SIGNAL CORPS ISSUE



AT ALL NEWSSTANDS OCTOBER 23rd

was discarded, again because of the double lines which relay control would require. A master a.c. line was substituted which ran throughout the system, and power supply for all the remote boosters was obtained from this



Front view of dual amplifier.

line. A master a.c. switch at the Main Administration Center controlled this supply and the booster amplifiers were turned on and off through this device. An emergency generator was also tied into this a.c. line insuring continuous operation of the system in the event of an air raid and the possible breakdown of the normal power system.

The emergency generator equipment was large enough to supply power to vital and strategic points in the area, but was not sufficiently large to serve all of the power requirements of the area. An additional advantage in running the separate master a.c. line to provide power supply for the remote boosters lay in the fact that in the event of normal power failure, the entire sound system could be switched over for emergency operation and though sections of the area might be without light no section would be without the alarm signal.

Since, as we mentioned earlier in the article, the prime function of the system was air raid alarm, it can be seen that an emergency power supply was mandatory. The system would be of little value, if in an emergency, it were to prove inoperative. This question of emergency power supply has become a vital consideration in all centralized sound systems, and it will be noted that some means is provided for it in practically every system described in these articles.

It will be remembered that in the discussion of the speaker layout, we indicated that various combinations of reflex trumpets were employed. It was decided to drive each trumpet with approximately 20 watts of power and in order to supply this, zero level 80-watt booster amplifiers were employed.

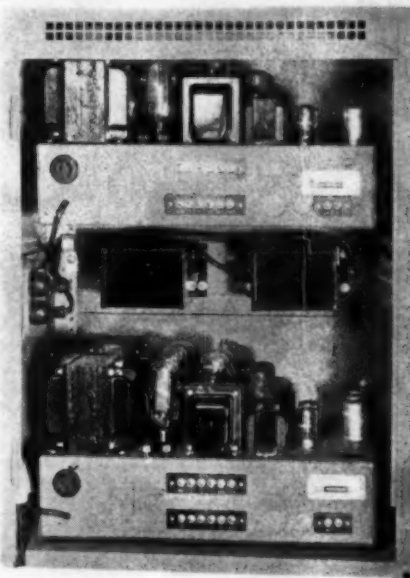
In those locations which required

more than eighty watts, two or more booster amplifiers were used, each amplifier feeding its own group of trumpets. Maximum protection against breakdown was achieved by employing booster amplifiers with two separate power channels and by feeding the output of each amplifier into its own group of speakers. Should one output channel of the booster breakdown for any reason at all, the other channel will continue to supply an undistorted 35 watts, and should one booster amplifier or the speaker feed lines for one booster open up, only a small number of the total number of trumpets would be inoperative.

Reference to the functional schematic will show that the first thirteen booster amplifiers are controlled by individual switches or in some cases, two boosters are controlled by the same selector switch. Thirteen of the last fifteen boosters shown in the lower half of the drawing, however, are controlled by one switch. Functionally, then, when switch No. 1 is depressed, booster No. 1 is driven by zero level input and it in turn drives the four reflex trumpets. When switch No. 5 is depressed, it drives two boosters, each of which, drives a group of 4 trumpets. Switch No. 11 controls 13 boosters simultaneously. These 13 boosters drive trumpets located in the Proving Grounds section—all of which, the Army engineers pointed out, were to receive every call or alarm simultaneously.

The last two boosters are of the double booster rack type and feed the trumpets which cover the master drill area.

The central control rack, itself, is shown within the dotted area on the



Rear view shows filter.

functional diagram. A monitor speaker is used to "listen in" on the programs being distributed through the system and also to check a program before it is distributed.

The tuner is a highly sensitive all

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Standard Electro-Voice engineering practise includes orders for "Test to Destruction" during manufacture and assembly. At frequent intervals, microphones are taken from our production lines and abused until they are completely demolished.



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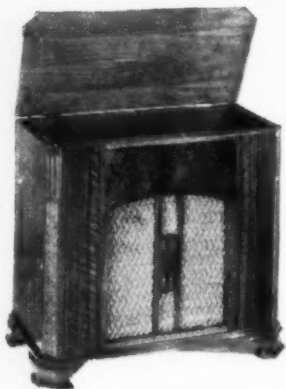
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Chicago

wave superhet, specially designed for rack work.

A power output meter indicates to the central control operator, precisely what level is being fed out of the line amplifier, which as we have previously indicated, should be maintained at zero db.

The various speaker selector switches are of the telephone type and are mounted on a separate switch panel.

The turntable employs a dual speed motor and will handle transcription records, permitting special transcribed broadcasts to be distributed.

The construction view of the rack shows the oscillator which supplies the air raid and all clear signals.

This then is the system as finally established. It is the answer to the many unusual problems which existed and which exist in one degree or another in every camp, war plant, air station or shipyard. The design of centralized equipment is obviously a rather complicated affair.

It is insufficient to be aware only of the standard conventional practice. It is impossible to design any one system which will serve all situations. Not only do area, weather and noise conditions vary—but considerations of available appropriations are vital. A new and increasingly significant factor is the need to minimize the use of copper cable. The designer of centralized sound equipment who can accomplish the requisite functions of the system with a minimum of cable is doing an additional service to the country by conserving the supply of copper and cable. The system described in this article has accomplished practically every feature of the relay controlled systems without the multiple wire which they require.

Future articles will indicate additional solutions to problems—solutions born out of necessity and resulting in a broadening of sound engineering's horizons.

—30—

What's New in Radio

(Continued from page 25)

ated and completely self-contained in a handsome, natural finish solid oak carrying case. It will undoubtedly find quick acceptance in plants where resistance testing has proved a stubborn bottleneck. Model 670 is described in Bulletin 126 free on request. *Radio City Products Co., Inc.*—127 W. 26th St., N.Y.C.

General Cement Chemical Laboratory

Here is a real professional Radio Chemical Laboratory that is complete in every respect. Twenty large 2 oz. bottles put up in permanent laboratory stand that can be placed on your bench or hung up on the wall. The stand is a permanent rack to hold all your Radio Service Chemicals and find them

when you need them. Every needed chemical and cement is included in this Laboratory for all kinds of Radio Re-



pairs, speakers, coils, contacts, dials, controls, etc. Every Radio Man, Radio Laboratory, Radio Engineer, and Radio Manufacturer will have use for this complete Laboratory—*General Cement Mfg. Co., Rockford, Ill.*

Heavy-Duty 50-Watt Power Rheostat

By simply enlarging the features of its 25-watt power rheostat which has scored an exceptional service record since its introduction almost two years ago, *Clarostat Mfg. Co., Inc.*, 285-7 N. 6th Street, Brooklyn, N. Y., now introduces its 50-watt unit.

This new 50-watt rheostat is virtually identical to the previously introduced 25-watt unit, except for its larger size. The selected resistance wire is wound on an insulated metal core which distributes the heat at intermediate rotational settings. A graphited-copper contact shoe rides the collector ring and the winding, assuring two positive sliding contacts. Contact pressure is provided by a helical spring, concentrically mounted about shaft whose action is evenly distributed by use of a tripod-type contact carrier. The contact is insulated from the metal shaft by a center ceramic insulator, thus providing a "dead" shaft and mounting bushing. Available in any resistance value up to and including 10,000 ohms. *The Clarostat Mfg. Co.*, 285 North Sixth St., Brooklyn, N. Y.

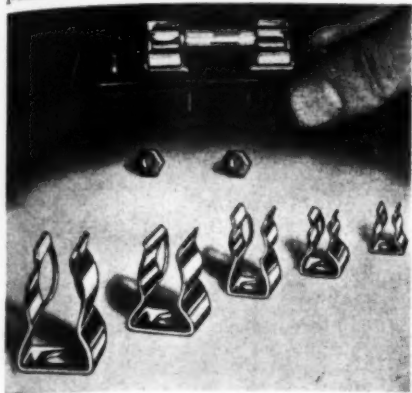
Microphone Switch

Universal Microphone Co., Inglewood, Cal., has announced a new microphone switch SW-141, available in quantity orders to government contractors. The assembly is housed in plain plastic case with hanging eye at the top and is complete with cable strain relief construction. The switch may be used as a press-to-talk type, or the locking button may be used on the "on" position.

Lightweight, compact, durable, SW-141 switch can be adapted for various communications devices for mobile units. It has been built, to specifications of the Army Signal Corps, by the *Universal Microphone Co.*, Inglewood, Cal.

Fuse Clips

Littelfuse Beryllium Copper Fuse Clips are made from a new alloy of Beryllium and Copper. This metal possesses unusual physical properties



that make it, in many respects, more useful than any other base alloy. Many manufacturers, especially in the aircraft and electrical industries have found that *Littelfuse* Beryllium Copper Fuse Clips under repeated stresses rate unusually high in life, in quality, and in saving of replacement costs. *Littelfuse* Beryllium Copper Fuse Clips are designed especially for aircraft use, and are recommended by the Civil Aeronautic Authority. In the absence of Army-Navy specifications, *Littelfuse* Beryllium Copper Fuse Clips have the tentative approval of the Bureau of Aeronautics, Navy Department, and the Army Air Force, Wright Field. Evidence to this effect is substantiated by the hundreds of thousands of these clips that have been delivered to the many aircraft plants in the United States, commercial air lines, the Army, the Navy, and to the British Purchasing Commission. *Littelfuse Inc.*, 4757 Ravenswood Ave., Chicago, Ill.

G. E. New Fluorescent Lamp Starter

A new manual-reset fluorescent lamp starter, called the "Master No Blink," which locks dead lamps out of



the circuit thus allowing instant dead lamp replacement, has been announced by *General Electric's* appliance and merchandise department at Bridgeport, Conn.

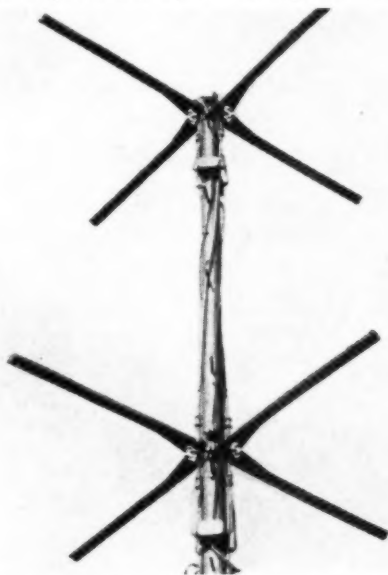
The "Master No Blink" starter with its manual-reset feature offers several advantages over the automatic starter. In automatic starters, a flow of current is required to keep the dead lamp from flickering. With the "Master No Blink," no current flows through the ballast after the dead lamp has been locked out. This current cut-off feature prolongs the life of the ballast. It also eliminates the "cooling" period which is required for replacement of lamps using automatic starters.

When the new "Master No Blink" locks a dead lamp out of the circuit, a small red button on top of the starter snaps forward. When the worn-out lamp is removed from the fixture, the red button is pushed in manually to reset the starter, without removing starter from the fixture. Lamps can be changed without shutting off the current.

At present, the "Master No Blink" starter is available only for 30-watt, 40-watt and 100-watt lamps. The respective identifying catalog numbers are FS-4NB for the 30 and 40-watt lamps and FS-6NB for the 100-watt lamps. Manufactured by *General Electric Co.*, Bridgeport, Conn.

Heated Radio Transmitting Antenna

Electric heat has been used successfully by frequency-modulation station W51R, Rochester, N. Y., to prevent ice



from forming on its transmitting antenna located atop one of Rochester's down-town buildings.

The antenna consists of two sets of hollow crossed arms mounted one above the other on a mast in a horizontal plane. Any icicles forming on these arms would endanger automobiles, pedestrians, and windows, since the antenna is mounted close to the edge of the building. To prevent the formation of ice, a four-foot *General Electric* Calrod heater has been built into each of the cross arms. The current to the heaters is turned on automatically when the temperature is within the sleet-forming range of 28—32 F.

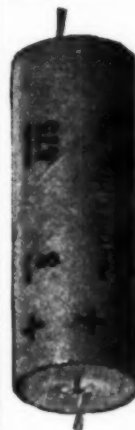
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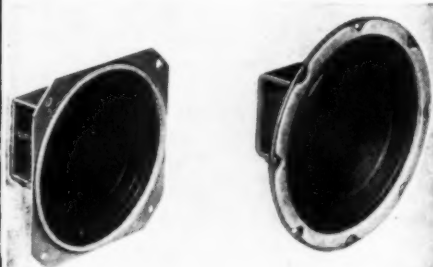
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Plays up to 12" records . . . your new
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P.M. SPEAKERS!—All new—thousands
in original cartons. 4" and 5", good
heavy construction. V. C. impedance
3-4 ohms. (Less transformers) 4" at
. . . **89c each** 5" at . . . **\$1.10 each**



NEW G. I. PHONO MOTOR. Model
CX 78 RPM. Gear driven. 9" turntable. Quiet
operation. Powerful synchronous motor, rubber
insulated from turntable. Positive direct drive
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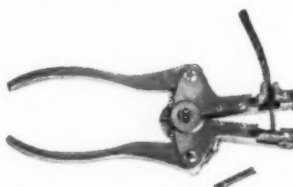
RANDOLPH RADIO
609 WEST RANDOLPH ST., CHICAGO, ILL.
"Millions of Parts for Millions of Radios"

This is accomplished by two thermostats mounted on the mast of the antenna. Both thermostats must be closed in order for the heaters to work. It is impossible for the heaters to function outside the temperature range of 28—32 F. since one thermostat closes when the temperature falls below 32 degrees and the other opens when it falls below 28 degrees.

During the past winter, there were several ice storms in Rochester, but at no time did ice form on the antenna. Manufactured by *General Electric Co.*, Schenectady, N. Y.

New Instant Automatic Wire Stripper

General Cement Manufacturing Company of Rockford, Illinois, announces an amazing new Wire Stripping Tool that saves time, money and trouble for Electricians, Maintenance Engineers, Mechanics, Sound Men,



Radio Men, etc. This new handy unit instantly strips insulation from all types of wire easily and perfectly. Just press the handles and the job is done. It can also be used as a wire cutter. Saves many hours of time when making splices, repair jobs, etc. For information write *General Cement Manufacturing Co.*, Rockford, Illinois.

Walsco Staple Driver

A new improved model of the outstanding Walsco Staple Driver is announced by the *Walter L. Schott Company*.

Their new model staple driver is now made with hardened steel inserts which prevent all possibility of jamming and clogging its automatic staple magazine.

Since its introduction two years ago the Walsco Staple Driver has proven a



great time and labor saver for radio, intercommunication and telephone installation men, and is now being widely used to speed up installations of plant intercommunication and air raid alarm systems. The fact that it quickly sets staples into otherwise inaccessible places and even into hard surfaces such as brick, plaster walls, or hard wood, has made this low priced tool indispensable.

The new Walsco Staple Driver Model 500A is now available at radio jobbers and telephone supply houses at the same price. Manufactured by the *Walter L. Schott Co.*, 5264 W. Pico Blvd., Los Angeles, Calif.

Versatile Recorder

(Continued from page 17)

the voltage to be absorbed on peaks. This offers considerable protection to the delicate crystal in the cutter and the use of such a protective device is recommended.

The jack for headphones is wired in series with the variable resistor R34. These two units are mounted on to the turntable motor board where they will be within easy reach of the operator. We found that approximately the full resistance of R34 is required for satisfactory volume level at phone. It is a good practice to keep that resistance value high to prevent a shorting effect to the cutter. Furthermore, the impedance of the headphones is 40,000 ohms.

Power Supply

A plate and filament transformer was selected to have small physical size, and yet one which would operate satisfactorily in conjunction with the amplifier. The circuit is conventional and needs no explanation. The illustrations show the mounting position for T3 as well as the two filter chokes L1 and L2. An extra receptacle is wired across the primary of T3 to receive the plug from the turntable motor.

Conclusion

A filter is necessary between the crystal pickup and amplifier, if proper reproduction is to be attained. The complete components for filter network are all included in the round metal can, as shown in the illustration. In addition, a metal cap has been added so that complete shielding is had for both the input and output leads, one going to the pickup connector; the other to the 6C5 grid.

Initial tests of the completed unit showed that there was more than sufficient overall gain even for outdoor applications, where the level was less than that which would be encountered for average pickup. One of the nicest features of using inverse feedback is that a greater amount of amplification may be employed within the amplifier without getting into trouble from the tube and circuit noises. Furthermore, the use of feedback tends to level off the response and helps to avoid unwanted audio peaks.

Several discs were cut in the studio, and the results were most gratifying. A typical set-up for a small room or studio is shown in one of the illustrations.

Those of you who complete the construction of this versatile unit will possess one having flexibility and one capable of giving real quality results. By utilizing two identical cases, one may carry the complete equipment and set-up in but a few moments' time.

We will be pleased to receive correspondence from those who have constructed this unit.

FM Treasure Locator

(Continued from page 24)

ing at angles to each other, they are ready to be assembled between the two handles. The transmitter loop is adjusted to about the center of its range

with receiver in position and over type of soil it is to be operated. Various types of soil will cause the FM Locator to have to be readjusted for that particular type of soil but when properly adjusted will work anywhere.

When carrying the Locator across a $\frac{1}{2}$ " water line 1 foot deep in the ground the meter will rise to almost

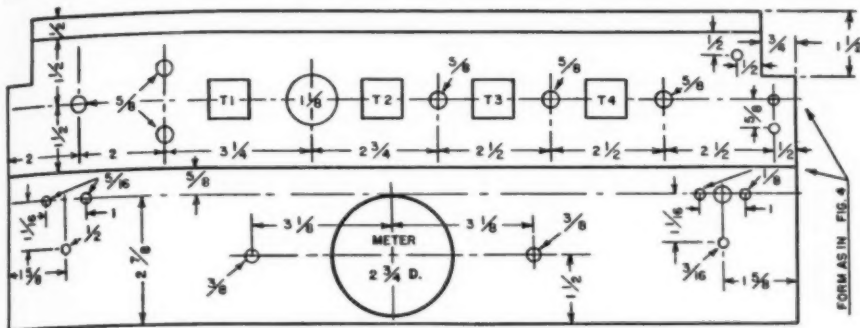


Fig. 3.

with tuning knob at top center of front panel, with receiver adjusted for maximum gain which is just under the regeneration point, the transmitter position is adjusted for minimum

full scale and a loud signal will be heard in the phones. A 4" water line $4\frac{1}{2}$ feet deep gave the same results. Metal objects on top of the ground do not respond as one would think they

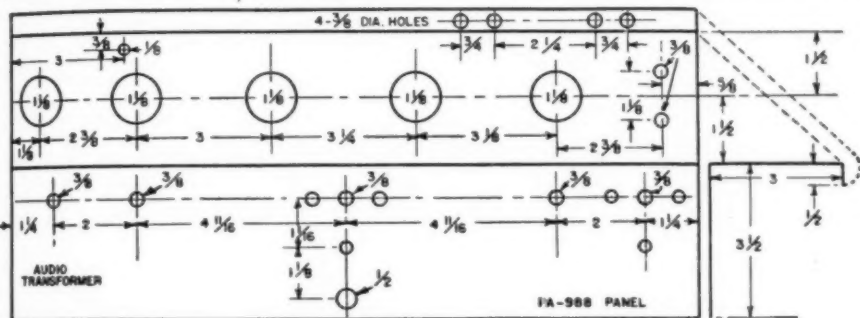


Fig. 4

meter indication and the wing nuts of transmitter are tightened and the $\frac{1}{4}$ " dowels are located and put in transmitter case. The proper location of these dowels is very important.

Operation

The two units as assembled are ready to test. Adjust the transmitter loop with tuning knob at top center of front panel for minimum reading of receiver meter, with receiver adjusted for maximum gain, then adjust so top of transmitter loop is slightly forward and the meter reading increases about ten or fifteen microamperes. This tuning should be done

would. This is a very good feature of this FM Locator. Small metal objects under the ground give good indications if they are not too deep depending on conditions of soil. This is due to the 3 mc. frequency used and possibly a FM. Lower frequency would work better for large objects at greater depths but the sensitivity would be very poor and that would impair the practical use of this FM Locator.

Now before you try to use this FM Locator get acquainted with the machine. Try it out here and there, find out how it responds, experiment, carry as close to the ground as possible.

-30-

Streamlining

SYLVANIA SERVICEMAN SERVICE

by
FRANK FAX



IT'S a matter of pride with Sylvania* that so many servicemen have always looked to us for the latest, best and most complete technical assistance and information.

Today scarcities of parts and materials are making the replacement problem a tough one. There are angles and situations popping up all the time unlike any you've had to face before.

So we've been busy revising and improving our technical data in the light of new conditions—to help you carry on as best you can for the duration.

Such things as the Tube Simplification Chart, for example, which details the list of Sylvania Tubes for which replacements are available, along with the substitute best adapted for each.

Or the Base Chart, which furnishes a complete cross-index of all our tube types and bases.

In addition, we have available a big array of sales helps—each designed to stir up new business for you—or to help you better serve the old business.

Look over the list below and pick out the ones you need. If your jobber can't supply you write to me, Frank Fax, Dept. N-10, Sylvania Electric Products Inc., Emporium, Pa.

1. Window displays, dummy tube cartons, timely window streamers, etc. (From your Sylvania jobber only)
2. Counter displays
3. Electric clock signs
4. Electric window signs
5. Outdoor metal signs
6. Window cards
7. Personalized postal cards featuring timely topics
8. Imprinted match books
9. Imprinted tube stickers
10. Business cards
11. Doorknob hangers
12. Newspaper mats
13. Store stationery
14. Billheads
15. Service hints booklets
16. Technical manual
17. Tube base charts
18. Price cards
19. Sylvania News
20. Characteristics sheets
21. Interchangeable tube charts
22. Tube complement books
23. Floor model cabinet
24. Large and small service carrying kits
25. Customer card index files
26. Service garments
27. 3-in-1 business forms
28. Job record cards (with customer receipt)
29. "Radio Alert" Postcards
30. Radio Caretaking Hints to the Housewife

*Formerly Hygrade

SYLVANIA ELECTRIC PRODUCTS INC.

RADIO TUBE DIVISION

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LAST CHANCE! National Inventors Contest Closes

Midnight, October 1, 1942

Winners will be announced in January, 1943, issue

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Induction Systems

(Continued from page 19)

wound with 140 turns of No. 22 enamel wire. Several taps near one end of the coil are made by removing the enamel for about one-half inch, making a twist and soldering. The tank condenser is a .006 mica condenser and a .001 mfd. padding condenser in parallel to give a total capacity of .007 mfd. This circuit will resonate at approximately 50 kc.

A 6F6G pentode tube is used with 250 volts on the plate and screen. An 85 millihenry choke keeps the r.f. out of the power supply. The tap adjustment on the tank coil requires some experimentation for best results. One end of the loop is grounded, the other end connects to one of the taps. As the loop is connected to the taps further from the grounded end, it will be noticed that the resonant frequency of the oscillator rises because of the loop inductance being in parallel with part of the tank coil.

This circuit of course will produce only a continuous wave, and may be keyed or interrupted by opening the cathode to ground circuit.

If a modulated transmitter is desired for induction communication it is best to use the electron-coupled circuit shown in Fig. 2 because of the ease with which modulation can be introduced. The 6SA7GT is particularly adapted for this type of circuit, and in conjunction with a 6C8G, a combination audio oscillator, speech amplifier, mixer and r.f. oscillator is obtained.

The oscillator section of the 6SA7 is connected to the same tank circuit as described previously for 50 kc. with the exception that all taps except one may be omitted. The remaining tap is approximately 1/3 up from the grounded end of the coil. A 250-volt d.c. power supply is necessary, the screen voltage of the 6SA7 being reduced by a 40,000 ohm resistor, and the plate receiving its voltage thru an 85 m.h. choke. The loop antenna is connected to the plate circuit thru a .1 mfd. condenser. Its construction will follow later.

The audio section of the transmitter consists of a 6C8G double triode. One triode section is used as a conventional audio amplifier, resistance-coupled to the control grid of the 6SA7GT. The other triode section works in conjunction with an audio transformer producing an audio frequency. A jack is inserted in the cathode lead for keying purposes. This audio section also couples into the grid of the 6SA7GT allowing voice and tone modulation at the same time if desired. An ordinary carbon telephone microphone is used—working into a mike transformer into the grid of the audio amplifier triode. A phono pickup may also be used by connecting it directly into the grid circuit if it is of the high impedance type.

This type of transmitter is constructed easily, the entire unit built on one chassis with a separate power supply, or built on the same chassis. A 50 kc. receiver must, of course, be used with this transmitter. However, if it is desired to operate at a shorter distance this same transmitter can be operated in the broadcast band with slight circuit revision. In this case an ordinary broadcast receiver can be used for reception. The only change necessary is to change the tank circuit of the 6SA7GT oscillator and alter the loop antenna slightly. For operation at 550 kc. the tank circuit is wound with 75 turns of No. 22 enamel on a 4" form. The tank condenser is a 250 μ f. padder. The loop circuit has approximately 40 turns of No. 28 enamel wound on an 18 1/2" square form shunted by a 500 μ f. padder. At this frequency it must be remembered that the signal strength cannot exceed 15 microvolts at a distance of 285 ft.

When operating in the broadcast band serious interference may result in neighboring receivers if certain precautions are not taken. It is good practice not to use the broadcast frequencies in congested areas but setting up the system to operate just below 500 kc. The main object in using 550 kc. instead of 50 kc. is that the system becomes much more efficient. Smaller loops can be used and higher voltages induced into them. The disadvantage, of course, is the smaller distance allowed for utilizing a 15 microvolt signal.

Receiver Design

The design of a 50 kc. induction communication receiver is shown in Fig. 3 consisting of 3 r.f. stages, a diode detector and power amplifier. The receiving loop is connected directly into the grid circuit of a 12SK7GT. Two more of these tubes follow with impedance-coupling from plate to grid circuits. The diode section of a 12SQ7GT tube rectifies the signal and it is placed on the grid of the triode section where it is resistance coupled into a 35L6GT output tube. A 5" p.m. speaker is used and power is supplied by the 35Z5GT half wave rectifier. A 100 ma. choke and a dual 30 mfd. fabricated plate filter capacitor filters out most of the ripple.

Impedance coupling is used between the r.f. stages because no commercial r.f. transformers are available for this frequency. They are constructed by purchasing the shielded type 125 millihenry r.f. choke coils and drilling a hole at the top of the can in which the 100 μ f padders are mounted. Since a comparatively large number of r.f. stages are used with a large loop in close proximity of the receiver, oscillation will become a major obstacle. Isolating resistors and condensers are provided. However, considerable care must be taken to provide complete shielding of each stage, of the loop lead-in and of the whole receiver itself to prevent oscillation.

As very few test oscillators are available for 50 kc., alignment of the r.f. circuits of the receiver is made possible by using the transmitter itself as the source of signal. A 0-10 milliammeter is inserted in the plate circuit of the 35L6GT output tube, and a .01 coupling condenser is connected temporarily to the grid side of the transmitter tank coil for coupling purposes. A test lead is connected from this condenser to the grid of the third 12SK7GT, the loop removed from the receiver, and the control grid of the first 12SK7GT grounded.

With the transmitter in operation, the padder on top of the plate impedance of the third 12SK7GT is adjusted for maximum dip of the 0-10 milliammeter. If a dip does not occur chances are the transmitter tuning must be changed to correspond to the receiver tuned circuits. After resonance has been reached, the same procedure is followed with the second 12SK7GT by changing the test lead over to the grid of this tube and aligning its plate impedance again for maximum dip. In aligning the first r.f. stage, the ground is removed and the loop connected into the grid circuit.

The transmitter is placed a few feet from the loop, and the plate circuit of the first stage tuned to resonance. The loop tuning condenser is now adjusted for maximum dip on the meter. The transmitter will probably have to be moved farther away to permit an indication on the meter. In all probability at this stage of aligning the receiver, oscillation will be noticed. This can be determined easily by a squeal in the speaker or by a very low reading of the plate current meter. The transmitter should be turned off at various stages of the alignment procedure to note whether the plate current meter returns to normal plate current. If it remains at a very low value oscillation is present and its cause must be removed before proceeding. In very stubborn cases, it may be necessary to place a 25,000 ohm pot in the screen circuit of the third 12SK7GT and reduce the screen voltage until oscillation is remedied.

After the receiver is aligned properly, the usual background noise should be present, diminishing as the transmitter is placed in operation.

Figure 4 describes a similar type of receiver, however, battery tubes are used and a sensitive relay is inserted in the plate circuit of the detector tube. This type of receiver is used only for induction control circuits on portable equipment. It was designed specifically for radio control of a model ship, however, it may be used for other purposes where battery operation and light weight is essential. This receiver uses a grid leak condenser type of detector in order to obtain maximum sensitivity. With only a 45-volt battery as the plate supply, the sensitivity obtained is fairly good.

Tuning is the same as of the a.c.-d.c. receiver previously described. The

contacts of the sensitive relay may be connected to a pulsing relay or selection circuit for control purposes.

Loop Construction

Construction of a loop antenna is not a difficult task if one is acquainted with the fundamentals of woodworking. After the size of the loop is determined, the four sides are cut and formed into a square and held in place with brads. Either wooden triangular corner braces or metal angles may be used in each of the four corners. If metal is used it should be placed over to one side and not directly under the loop winding.

The stem or support of the loop can be made of any wood stock available and bolted to two of the corner braces. All of the woodwork should be treated with several coats of shellac before winding. The padding condenser may be mounted on one of the corner braces if called for.

Operation

The successful operation of induction control systems depend mainly upon two factors, the efficiency of the loop antenna and the sensitivity of the receiver. The fact that the efficiency of a loop varies indirectly with the frequency if the size remains constant leads one to believe that the higher frequencies should be used. The decision as to the frequency to be used depends wholly on the distance to be covered. If large distances up to 3000 ft. are to be covered, 50 kc. must be used in conjunction with large receiving and sending loops. If shorter distances are called for we may go up in frequency and use much smaller loops with greater efficiency. By all means the highest frequency possible should always be used for the distance covered.

The 50 kc. circuits described in this text should only be used for distances of 3000 feet. The average radio experimenter can easily remove turns from the plate impedances of the receiver circuits, and from the tank coils and loops of the transmitters if a higher operating frequency is selected. It is merely necessary to remove turns from the transmitter first, and then cut down on the inductances of the receiver by using the alignment procedure previously described.

The average ham or experimenter has been toying with circuits involving wavelengths of 200 meters or below. Since induction transmission utilizes wavelengths of from 500 to 6000 meters an entirely new situation prevails. The size of inductances and radiators become increasingly important and the higher the wavelength used, the more inefficient our systems become.

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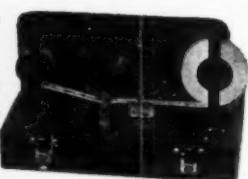
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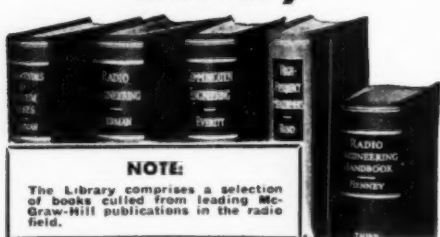
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for neighboring radio men all using induction transmission are waiting to be developed. We need not feel sad because we cannot hear our fellow ham's voice booming out of the speaker. Get together and build an induction system. Even though the distance is short, the thrill of communication still prevails.

—30—

Practical Radio Course

(Continued from page 29)

flow of their currents, and rejecting the signals of unwanted stations (operating on a different frequency) by presenting a high impedance to the flow of their currents. It can easily be seen that if either the capacity or inductance values (or both) in the series tuned circuit are made properly adjustable, they may be varied to produce resonance for any given frequency within the limits of the electrical values of the coil and condenser used. In the majority of commercial receivers, for numerous reasons of electrical and mechanical practicability, a variable condenser rather than an adjustable inductance is used.

Tuning, as generally performed in radio receivers, consists essentially of setting the electrical values of certain circuits to admit desired signal voltages of one frequency (the wanted station), while excluding those of all other frequencies (all other unwanted stations). A series tuning arrangement which illustrates this action in its most simple form is presented in Figure 4. The simple system for receiving broadcast radio signals of one station at a time consists of an elevated aerial wire in which the signal voltages are induced by the various broadcasting stations operating in the vicinity at the time, and a ground connection to complete the energy collector system. The induced signal voltages send currents through the series circuit composed of the fixed inductance (tuning coil) and condenser of adjustable capacity (tuning condenser). Each broadcasting station is assigned by the Federal Radio Commission to send out radiations of a different frequency; those of station WMCA are at a frequency of 570 kilocycles per second, those of WJZ are at 770 kc., etc. All of these will induce signal voltages of corresponding frequencies in the antenna system. The strength of the signal current each of these voltages is able to set up in the series circuit depends upon the net impedance which the series circuit presents to currents of that particular frequency. Therefore, to receive only the signal of a particular station, say that of WHN at 1050 kc., we must adjust the capacity of the series tuning condenser to the correct value to make the circuit resonant at 1050 kc. The 1050 kc. signal voltage of station WHN will then be able to cause a stronger

signal current to flow in the circuit than will the signal voltages of all the other stations, and WHN will be heard above all the others. (Of course, in this discussion, we have purposely neglected to consider several factors such as the relative strengths of the incoming signals of the various stations, etc., but these are not important at this point.)

Selectivity is a measure of the extent to which this action of rejecting the signals of all the unwanted stations from that of the wanted station is achieved. A tuning circuit is said to be selective when it enables complete rejection of all signals of unwanted frequencies, even those which lie quite close to that of the desired signal. All receiver-tuned circuits should provide good selectivity for proper rejection of the signals of unwanted stations. In practical radio receivers, more than one such tuned circuit is employed in order to obtain the required degree of selectivity.

Resonance in the Parallel L-C Circuit

Resonance may also be produced in a parallel circuit composed of an inductance L, and a capacity C as illustrated at (a) of Fig. 5. An alternating current views this parallel circuit as a capacitive reactance in shunt with an inductive reactance.

And in flowing down through this combination, the current will encounter separate impeding effects in the two legs, the two reactances acting to impede it by different amounts depending upon the frequency of the applied voltage and the electrical values of the coil and condenser.

At some one critical frequency, for any given inductance and capacity values, the inductive reactance and capacitive reactance will be equal. Because of the nature of the two kinds of reactance, the current-impeding action of the circuit will be almost entirely due to the capacitive element at frequencies below this critical frequency, and largely to the inductive element at frequencies higher.

This is illustrated by the reactance graphs at (b). At this critical frequency of resonance however, since the two reactances are equal, the condenser current (I_C) must be equal to the inductive current (I_L). Since these currents are opposite in direction at every instant, they balance each other. Consequently the total line current I is a minimum under this condition, and determined simply by the ohmic resistance of the circuit.

This type of tuned circuit is used in wave traps or in filters where it is desirable to suppress or reject currents of a certain frequency and pass others. It is also employed in some of the tuning circuits of superheterodyne receivers.

(To Be Continued)

THE FUTURE OF ELECTRONICS

ELECTRONICS is the new science for the new world, and the bright promise for the future, the General Electric Company points out in its July quarterly report to its stockholders. The report follows:

"Human beings, with a natural flair for the dramatic, like to dwell on the great 'accidents' of science which have served as humble foundation stones for tremendous achievement. Among others they list Newton's apple, Galvani's twitching frog legs, the destruction caused by lightning in Steinmetz' cabin on the Mohawk. Accidents? Not really. Rather call them legitimate by-products in the unending search for new knowledge, call them unsuspected doorways along the rich corridor of scientific study. The corridors, the whole research structure, and the trained men had to exist, of course, before the 'accidents' could happen.

"Perhaps the greatest 'accident' of all was the Edison Effect. It came about in 1883, when Edison observed a bothersome phenomenon in some of his lamps when they were first lighted. It was a glow between the filament terminals, accompanied by a rapid disintegration of the filament. Investigating, he found the glow was due to current passing between the terminals, and that a better exhaust eliminated the glow. There Edison—and the rest of the world—paused for several years, unimpressed by the fact that the phenomena of electronics had been recorded for the first time. The 'glow' was actually an electronic gaseous discharge. It remained for Thomson, Fleming and DeForest, Langmuir, Richardson and Hull to build that accident into a whole new science. Today we say: 'Electronics is the new science for the new world, the bright promise for the future.' In that future General Electric is destined to play a major role.

What Is Electronics?

"What is electronics? It is the science of the electron. The world of substance is built of molecules. Molecules, in turn, are various combinations of atoms, or elements. Continuing this simplified, but fundamentally accurate explanation of the structure of matter, it might be said that atoms consist of a nucleus of neutrons and protons, around which negatively charged electrons whirl as do the earth and other planets about the sun. Through the medium of the vacuum tube it is possible to separate these electrons from the atoms and put them to work.

"In Edison's lamp, negative electrons, rushing from the hot filament, had no place to go until he sealed a wire, or anode, inside the loop be-

tween the two legs of the filament, and sent the electron flow, or current, from filament to 'plate,' or—in electrical language—from cathode to anode. The rest is one of those fascinating, painstaking scientific stories which rightly has no ending but only new chapters. In the first application of the Edison Effect, Professor Fleming developed a detector for wireless telegraphy, called the 'Fleming Valve.' Lee DeForest followed with the vacuum-tube grid, a small charged wire screen to control the flow of electrons through the valve. Armstrong found how to use DeForest's discovery to amplify radio-frequency waves, and thereby put an end to the earphone era. Langmuir designed a high-vacuum tube which would handle watts and kilowatts, instead of merely fractions of a watt, and which could amplify the impulse of a microphone to tremendous power for radiation from an antenna. This was another key, to an even larger room—that of radio-broadcasting, and the work went on.

Tomorrow's Promise

"For this generation radio is still an amazing and unbelievable thing, even though it has become as familiar and commonplace as plumbing and the automobile. In the wonderful mansion that is electronics, we have tarried longest in the room called radio because the experience has been pleasant and exciting. Electrons are as elemental and ubiquitous as fire. Fire made light and heat for centuries, as men rose in the scale of civilization, and that seemed to be wonder enough until they discovered stoves, and boilers for steam, and turbines for power, and saw that fire was not an end in itself but a tool of many uses and a new starting point. Something similar has been happening in electronics. Today we can have radio and television; tomorrow we can have much more, as new blessings are tumbled from that scientific cornucopia which is the vacuum tube. Even today these tubes range in size from tiny globes to cylinders several feet in length; they serve the doctor, the fireman, the artist, the fruit grower, the sea captain, the air pilot, the policeman, the manufacturer.

Now, with that magical Aladdin's lamp, the electron tube, the engineer can command electrons so that they will do his bidding. For the first time he has hold of electricity itself—not just its manifestations. All that has gone before, important as it has been to our lives and fortunes, may well be only a preparation for a new and greater adventure in living. And that is why we say: 'Electronics—a new science for a new world.'

—30—

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SENDING HELPS FOR THE BEGINNER

by Frank L. Velten, Code Instructor, RCA Institutes

"YOUR sending? Confidentially, it's unreadable!" All too often a Code Instructor will express in more or less picturesque language his opinion of a beginner's fist, yet fail dismally in offering constructive advice. The average code expert forgets the struggles of his early days in acquiring skill, and either leaves the stumbling beginner floundering in his own morass of haphazard dits and dahs with some soul corroding remarks, or else conveys with the impression, expressed in a most condescending manner, that a real operator, to wit himself, never had to learn code but was one of Nature's sublimest miracles, he was born with the code in his head and a bug in his hand.

It's about time somebody got human and gave the beginner a few prods in the right direction, instead of pushing him around ruthlessly and then offering no corrective advice regarding his faults. Some beginners can get on a key and just naturally begin to send good stuff, however, the majority of novices start off with a multitude of errors that multiply as their speed increases.

There is many an old timer on a circuit today who would get red ears if he saw his stuff put on a tape, and whose sending can be read only because the operator at the other end has specialized in "copying behind," studied mental telepathy, and perhaps has a crystal ball and a ouiji board in the radio shack as last resorts. It is up to Code Instructors and old timers to get busy and help the youngster in the game. It can be done if a few years are rolled back and some honest facts are brought to light, facts that were forgotten when the first commercial ticket was obtained and "there was nothing more to learn."

The "Cootie" key, with its short dashes and square dots, died a lingering death of natural causes, but the "Blurping Bug" still pollutes the air much as the Japanese beetle fouls the rose garden. How about the hand key for low speed transmission, or is it still necessary to send 20 wpm on a 50 wpm bug that sounds like a cross between a ginned-up woodpecker working on an eavespout and a flock of chickens picking up corn on a tin roof? The beginner has to start on a hand key, very often with no one to help him. Let's give him a hand right now. Here goes.

First . . . Adjust the key so that the contacts aren't open more than the thickness of a very thin dime, then adjust the key spring with only a moderate tension. The idea of the spring is only to open the key for you, not to develop your biceps in fighting it.

Second . . . Roll up your shirtsleeve and put your bare arm on the table.

The funnybone should never leave the table during transmission and if the beginner is reasonably well upholstered the arm will "float" on the muscles between the wrist and the funnybone.

Third . . . Keep the sending arm as limp as a dish-rag and slide it over until the fingers touch the key. Now, put the index finger so that the tip on the finger just barely rests on the far edge of the keyknob, not going over the edge. Next, put the second finger so that the little cushion of that finger goes over the edge of the keyknob about one-third the length of the first joint. If you now take a side glance at the position of your fingers, you will see that both fingers are in the same arch, thus each finger will do its share of the work.

Fourth . . . Arch the spine of your wrist about three quarters inch from the table. Now, keeping the wrist absolutely flexible and limp, bend the wrist down without letting the fingers grow either taut or limp. Now raise the wrist to the starting position and raise and lower the wrist in slow and machinelike precision until a uniform succession of dots are produced. Remember to keep the fingers in an easy arch but do not let them cave in or in any way react against the natural wrist motion. Do not remove the fingers from the keyknob.

Fifth . . . Forget about your thumb!!! Keep it away from the key for the time being. Curl up your third and little finger loosely under your palm, enough to clear the table, but don't curl them tightly.

Sixth . . . Try to get the "feel" of the key, the little cushion of the second finger tip will act as sort of a cat-paw and prevent slipping off the keyknob. Do not curl the "sending fingers" in too steep an arch or they may stiffen during the periods when the key is depressed and result in fatigue and a jerky style of sending. Do not have the arch of the "sending fingers" too flat or the wrist may be called on to supply too great an arc for clean key contacting. Keep the wrist going up and down, avoiding all tendency of the hand to wobble sideways.

Seventh . . . Practice making good solid dots with a clock in front of you and take your time. Try running off a full minute of good honest dots until your cadence and duration of length of dots does not vary. Use a good honest wrist motion and a firm closing of the key, avoiding too heavy a muscular down stroke, yet also avoiding too feathery a touch. Count your dots as you watch the clock for a minute while practicing and you will be surprised to find that you can knock off

(Continued on page 64)

Book Review

(Continued from page 33)

sents essentially a reorientation of viewpoint rather than a choosing of topics for an excessively specialized purpose. The book opens with a brief review of the elements of circuit theory and electron tubes. Thereafter, following the outline, it presents in unified manner, material required as the minimum basis for technical work in the U.H.F. field. In certain sections, subject matter is included which exceeds that which is required as the minimum basis, in order that the book may have even wider application. It also contains much necessary material from other fields, because U.H.F. work requires the use of many low frequency circuits and bases of equipment. Consequently considerable material from communications courses is presented in condensed form, so that the student can work continuously through this book without referring to others as he proceeds.

The style of presentation is most excellent. There is no repetition and one subject follows another in most orderly fashion. One cannot help but anticipate with great interest the following pages and one's enthusiasm increases as the book is studied.

We sincerely recommend this book as a "must" for those endeavoring to increase their knowledge of the U.H.F. field.

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QRD?

(Continued from page 33)

happened until it was all over. And then they came out with the argument that the Bill required the radio-op to join the Naval Reserve; which if it were true, would have been a damn good idea. However, the Bill said nothing mandatory about joining the Reserve; it merely said he would have to apply in the same manner as other officers on merchant ships. If he were turned down by the Reserve, he could still sail on his ticket and be classified as a ship's officer. Such legal status might help the op tremendously in getting an advanced rating if he were called into the armed forces. Apparently the ACA figured that as officers, the radio-op would be less inclined to spend their time soap-boxing with the firemen, so they deliberately butched any attempt by dues paying membership to gain legal recognition. These few points occurred to me while reading various notes in your column, and with the op's status as flexible as it is in the Merchant Marine, I wondered if anything was being worked out about it. Altho the op's life is probably not as free and easy as it once was, I imagine you get some interesting stories from them that might look pretty good in print. 73 . . ." Brother Price definitely has something there and we hope that radio ops in general

will be able to see which side of the fence gives the best view.

OUR roving, or should be say roaming reporter, CB, is now parking his tootsies in LaGrange, Ill., and advises us he has a soft billet as Radio Inspector in this area. Says he, "Started puzzling over what had happened to one of my pals who had been riding a tanker on the east coast prior to December, so last month I dropped a line to his home QTH. No answer for quite a while and I decided he must have allowed a sub to get too close. Then a few days ago along comes a letter, seems that same had happened. It came close enough for him to take one good look at it and he decided then and there that there were some nice shore jobs waiting for him. Now, b'gosh, he's working for the same outfit I am, although in a different department. The pay-off is this, tho. For his first job he was sent off on a little sea trip to one of our possessions. He volunteered for the job, too, so after three months Al Segen finally got back long enough to tell me he was still in the business. Like Maynard, he will go sailing again if no one else will. Here at the plant where I am now is Vernon Wright, one time relief op at Broadcast WIBU, Poinette, Wis. He's also with the Signal Corps but represents a different district. I suppose there are plenty of the gang spread around through the S.C. now and saying very little about what they are doing. The regs are rather strict that way, and ye ed says this would be good dope for every one, regs or no regs because "a slip of the lip may sink a ship."

BROTHER FRANK S. RIVERA out of Alice, Texas, has been trying to contact the VWOA for membership for some time past and says but for our column of last issue would never have known their address. He is now being rushed the necessary forms and it is hoped he will align himself with this noteworthy organization.

BROTHER CORPORAL JAMES L. WILMETH of the 38th Fighter Squadron, Tacoma, Wash., wants to know what will be the opportunities in commercial radio operating after the war. Not being good at guessing, we leave this question unanswered inasmuch as we feel that ship side radio operators are needed now and the more ship side operators the quicker this shindig will be over and the quicker we'll be able to give Brother Wilmeth his answer.

AND so me hearties with this we come to the end of another line of thought, with verbal quips and darts being thrown and received with that camaraderie between radio men who, in spite of personal and political differences, still love each other, sharing all the hardships and trials of the profession. So with a cheerio and 73 . . . de . . . GY.

-50-

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Sending Helps (Continued from page 62)

one hundred good solid dots per minute with no wrist fatigue. When you get so that it is purely mechanical and practically effortless you will find that one hundred and fifty dots per minute will be easily attained.

Eighth . . . When wrist control is attained, some letters and numbers may be attempted. E, I, S, H, and 5 may be run off on the key, always holding back that urge to speed up the dots when you come to an H or 5, a natural temptation and one that may be instrumental in producing "just another lousy fist." Now the letters containing dots and dashes may be attempted, but with a word of warning. Don't push the key down any harder for a dash than you do for a dot!!! This is important for the average beginner virtually slugs the key when making dashes for the first few hours of instruction. Use the same motion for a dash as you do for a dot, just keep the key closed three times as long for a dash as you would for a dot. (Some Instructors in the past have advocated that the hand be elevated for a dash instead of using the usual down motion of the wrist, the same as for a dot. Such statements have evoked considerable amusement among intelligent, clean fisted operators.)

Ninth . . . Various letters, such as V or B, may occasionally bother the beginner, there being a tendency to send the V as S and T. To avoid this letter-splitting of the V, make a nice smooth H. Do it a couple of times. Then start to make an H and when you hit the last dot just squat on the key and a perfect V will result. A letter B may be conquered in the same fashion. The letter C is often a headache, frequently being sent as N and N. To conquer this you might make a K a number of times perfectly. Then send K and E. Now send them again and put them together after a few tries and you will have a perfect C. Conquer the difficult F by a combination of U and E joined together in the same manner. Always think of a letter as being sent in a monotone of short and long sounds and not as a razor edged collection of long and short bricks hurled at the receiver at random.

Tenth . . . Smoothness of sending is acquired only by faithful concentration of wrist and brain. Try conscientiously to criticize your own formation of characters and work hardest on the letters that are most difficult to transmit. Analyzing your own stuff is difficult but it can be done to a certain extent. If you can put your pride in your pocket and ask a bona-fide expert for a ruthless criticism of your sending, you may learn where your most glaring faults lie. Friends will usually tell you little because they don't want to hurt your feelings. If they can read your stuff at all they

will tell you it's excellent although it may be very terrible stuff if you ever put it on a tape or phonograph record. Many a man has been horrified to find that he couldn't read his own sending after making a phonograph recording of his transmitting.

Eleventh . . . Sending practice material should be such that it contains every letter of the alphabet with few extra letters, thus giving X, Y, and Z as much of a workout as C and Q which are usually worked to death. "Pack my box with five dozen liquor jugs" and "The quick brown fox jumped over the lazy dog's back" are excellent practice sentences, having very few repeated letters. Practice from newspaper copy should be avoided due to a preponderance of easy words and mighty few of the XYZ variety, probably the reason why so many beginners are very weak on these letters.

Twelfth . . . Next in importance to clean character keying is the necessity for accurate spacing. If characters be made accurately and generous spacing is used, then the sending will be read easily. While not condoning poorly executed characters, it must be admitted that well spaced sending, even though the letters be faulty, can be read by an experienced operator. It is well for the beginner to space at least twice as much as he believes necessary and his stuff will probably be about right. It must be remembered that the accurate spacer is resting his wrist every time he spaces between letters or words and hence can handle a hand key for long stretches at a time.

Old timers will tell you of the operators on the transatlantic liners who could keep up a sweet smooth 22 wpm hour after hour and of coast station men who worked those same liners tirelessly and easily, seldom requesting repeats and often handling messages in series of five or ten. In one of the oldest and most important coast stations on the Atlantic coast that worked long distance with the transatlantic liners the manager refused to permit a bug used in the station. He found that a tireless 22 wpm would handle more traffic with less wear and tear on all involved than a dot-spitting bug in the hands of a crack-pot would be "speed merchant."

Thirteenth . . . Reasons for faulty sending are enumerated here.

1 . . . Improper wrist motion, not enough motion up and down, too much tenseness in wrist and lower arm. Relax the arm all the way to the armpit.

2 . . . Rolling the wrist sideways, resulting in uneven dot letters. Keep the wrist motion straight up and straight down.

3 . . . Caving in of the fingers when the key is depressed. This nullifies the normal wrist motion to some extent because a double and uncertain motion is applied to the keyknob. Keep the fingers firm but not rigid.

4 . . . Stiff fingers, locked at the sec-

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and joint instead of being in an arch and having a certain amount of natural resilience. Relax, but don't let your fingers get rubbery either.

5 . . . Pulling back. This is a common and serious fault with beginners and old timers. It is a natural tendency to use the fingers too much on the dot letters, the S, H, and 5 frequently being made by a combination of fingers and nerves. In an effort to make a snappy 5 or 6 the average man forgets to "float his wrist" and instead uses his finger tips in an effort to put over the fast character. He unconsciously pulls back again the keyknob, tightens his fingers and hand and often makes only a blurb of a character. This makes for uncertain sending at any speed and creates a mental hazard to any operator who has to handle numbers or code groups for long periods of time. It can be cured in five minutes by any Code Instructor worth his salt who has only to explain to the beginner or the "glass armed" old timer that a muscular wrist motion straight up and straight down means absolute control at reasonable speed.

6 . . . Fatigue when sending. This is due to tightness somewhere between finger tips and armpit, too much nerve motion and not enough wrist, or perhaps slugging the key too hard and fighting a strong key spring. Lay off sending for a moment, put your arm, palm up, on the table and roll your arm from side to side. At some point you will find a position where your arm is most relaxed and comfortable. Now place your hand in sending position again and roll your arm and relax your muscles until you find a position where your arm seems devoid of tenseness and feels perfectly relaxed. Now, get on the key, keep the "floating in oil" feeling in your wrist and arm while you are sending and you will soon be able to laugh at fatigue.

7 . . . Relieving wrist fatigue. After a long stretch of sending when the muscles begin to tire they may be relaxed quickly by a simple method. Simply let the arm drop loose at the armpit, limp and flabby as a wet rag, then shake the wrist from side to side so that the fingers flop around like a scarecrow's sleeve in gusty weather. Even a few seconds will produce a sense of marked relaxation. This same procedure works equally well when an operator has been copying with a pencil over long periods of time.

8 . . . Glass arm. Many an operator has had his arm go bad on him after he has been called upon once too often to send high speed traffic for too long periods. Very often a so called "glass arm" can be brought back to useful speeds if the operator has patience and perseverance. To do this he must begin to learn to send all over again, using an exaggerated wrist motion and sending very slowly and painstakingly and forgetting that he ever used his nerves and finger tips to put over the snappy stuff. The original high speed may never be attained, but a read-

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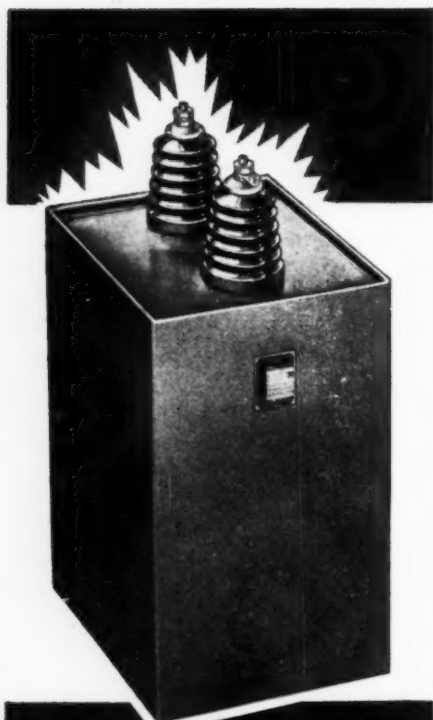
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able fist for moderate speed work may be the reward of many old timers who figured they were washed up because the abused muscles had rebelled and refused to make a comeback. It may be a long up-hill grind and the rebuilding of an old fist may be difficult, but it can be done.

My critics will ask a lot of pertinent questions, and I'll forestall a few right now and set forth my justification of my belief in what I write and practice.

Why is the thumb held away from the key?

Because the thumb, when pressed against the key, draws a tendon taut which prevents the wrist from bending easily and normally. If you want to prove it, put your wrist on the table with the palm of the hand up. Pull the thumb in toward the center of the palm and you will see a tendon tighten diagonally across the arm, opposing the other tendons in the wrist. Better yet, hold your bare arm in the air with the fingers pointing toward the ceiling and pull the thumb over toward the center of the palm. Bend your wrist and you will find it is quite stiff. Now try the same trick with your thumb held loosely apart from the fingers and you will find that the wrist flops over easily and without effort.

Why do you insist that the beginner put the "cushion" of the second finger on the key?

Because the student then gets the "feel" of the key and can control it from any position. An operator who uses this grip can send readable stuff whether he is seated at the desk of a coast station or is trying to keep right side up when the old wagon "takes it green" over the fore-castle head or rolls over on her beam ends when a big one hits her solid.

How can you get up speed when using a wrist motion?

As the operator gains transmitting skill he eliminates some of the wrist motion he started with for the obvious reason that he has trained his muscles and requires less of a wrist "arc travel" than when he first started. Familiarity with the key when clean control has been achieved will result in the sender using his fingers to a certain degree, in order to "shade" his sending and enjoy that enviable reputation of having a "perfect fist."

What have you got against bug keys?

Absolutely nothing! A bug which uses dots in proportion to its dashes in the hands of an experienced man can make mighty pretty music. The bug is the most abused piece of apparatus in the radio game but only because it is mishandled by a few crackpots who would rather repeat a message three times at 40 wpm with feathery dots than slow down to 30 wpm with normal dots and get an O.K. the first time. Pace a good tape machine some time and find how your dots check up with the auto; it may prove quite revealing.

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